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BANARAS HINDU UNIVERSITY

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2. To promote learning and research generally in Arts and Sciences in all branches.

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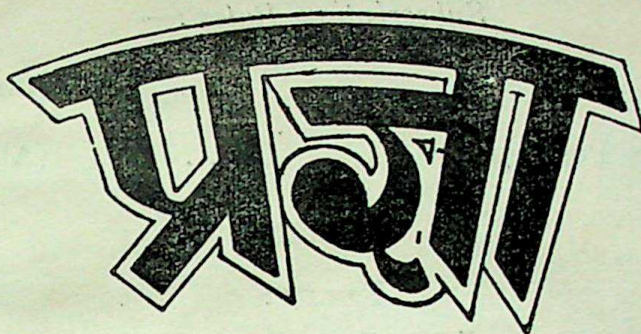
4. To promote the building up of character in youth by religion and ethics an integral part of education.

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विश्वविद्यालय के संस्थापक

पूज्य महामना

हिताय सर्वलोकानां निग्रहाय च दुष्कृताम्,
धर्मसंस्थापनार्थाय प्रणम्य परमेश्वरम् ।
प्रसादाद्विश्वनाथस्य काश्यां भागीरथीतटे,
विश्वविद्यालयः श्रेष्ठः हिन्दूनां मानवर्धनः ॥

जन्म :—वि० सं० १९१८ पौषकृष्ण ८ (२५-१२-१८६१)

मोक्ष :—वि० सं० २००३ मार्गकृष्ण ४ (१२-११-१९४६)

विषय-सूची

———

अक्षरमाला

ब्रह्मर्षि दैवरात, ब्रह्मचर्ययोगाश्रम, गोकर्ण

ओमिति योऽसौ स्वरति बलीयः प्राणो बहिरदसाऽक्षिणि मेयः।
ओमित्ययमहमाऽन्तर्ज्ञेयः सोऽसावयमिति तपसा ध्येयः ॥१॥

अः प्रथमाक्षरमात्राविदितः सार्वत्रिक आदित्यवदुदितः।
अमिदं ध्यात्वा ऋग्भिर्लोके स्वनुभवति हि महिमानं प्रथमे ॥२॥

आत्मरसात्स्वयमाश्रितविदुषः स्वात्मनि समभिनिवेशयिता यः।
आनन्दं तं परमिह लब्ध्वा परमभयं प्राप्नोति विदित्वा ॥३॥

इन्ध इति प्रमितोऽयं पुरुषो योऽसौ पुनरक्षिणि विनिविष्टः।
[1]ईन्नित्याहुरदर्शमितीदं तमिमं सन्तमिदंद्र–मिहेन्द्रम् ॥४॥

ईष्टे जगतामिति स पुराणो भूतानामिह पर ईशानः।
ईशानी सा परमा शक्तिर्या परमस्य प्रथमा दृष्टिः ॥५॥

उमया सहितं तं परमेशं ध्यात्वा मृत्युं तरति स शोकम्।
अविति ध्यात्वा मात्राद्वितयं यजुषा सोमं जयति सलोकम् ॥६॥

ऊर्ध्वमधस्ततममृतं पुरतो दक्षिणतश्चोत्तरतः परितः।
ऊर्जमुपैति हि हृदि भूमानं परमं तं परिदृष्ट्वाऽऽत्मानम् ॥७॥

ऋतमिति यत्परमं पदमुक्तं तदिह महाव्रतमिति परिगीतम्।
ऋच्छति तेन च परमममृतत्वं हित्वा मानुष्यकमनृतत्वम् ॥८॥

ॠकारेऽक्षरशक्त्या सहितौ मोचिकयाऽतिथिवामनदेवौ।
ॠकारोऽक्षरदैवतविद्भिर्विन्यस्यो नसि वामे सद्भिः ॥९॥

लृतिवर्णे नवमे सह शक्त्या स्थाणुश्रीधरदेवौ परया।
लृत इह दक्षिणगण्डे विदितो विन्यासः खलु शाक्तागमतः ॥१०॥

ॡकारे हरिरुदितो दशमः सूक्ष्मा शक्तिर्हर इह परमः।
ॡकारोऽक्षरतत्वसुवेद्यो वामे गण्डे खलु विन्यस्यः ॥११॥

एनोभिर्निखिलं परितप्तं दृष्ट्वा परितः परमाकुलितम्।
एजन्तं परिगृह्य हि लोकं परदेवो वः शमयतु शोकम् ॥१२॥

ऐमिति निगमचतुष्टयमूलां वाचं देवीमाहुरमूलाम्।
ऐमिति वाचकबीजकजपतः सद्यो वाग्मी भवति स युक्तः ॥१३॥

ओमिति यदिदं खमिति निगदितं परममनन्तं ब्रह्म तदुदितम्।
ओमित्येतेन हि समुपास्यं तदिदं प्रणवस्येह रहस्यम् ॥१४॥

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[1] ईन्न् इतीदं "इदमदर्शमितीऽ३" (ऐतरेयउ०) इत्यस्यानुकरणं।

औपनिषदपरतत्त्वमिहेदं वेद्यं वस्त्वखिलैः परमेकम् ।
औदासीन्यं बहिरिह विषयेष्वौदार्यं जगतामुपकृतये ॥१५॥

अन्तर्बहिरपि समभिनिगूढं रूपं चित्परमस्य तदेकम् ।
अन्तरिहैव हि रहसि गुहायामन्तर्वेदद्दशैव सुगम्यम् ॥१६॥

अस्तीति श्रुतमिदमिति कैश्चित् युक्तं नास्तीत्येव कुतश्चित् ।
अस्तीत्येव तदुपलब्धव्यं तदिदं त्वपरोक्षादनुभाव्यम् ॥१७॥

कः प्रजनानां पतिरिह पूर्णः प्राणयिता हृदि यः पवमानः ।
कमिति श्रुतमिह तदु समुपास्यं यदिदमुपस्थितमन्तर्हृदयम् ॥१८॥

खमिति श्रुतमिति यद्वा प्रथितं कमिह तदिष्टं कमपि खमुदितम् ।
खमिदं संस्थितमन्तर्हृदये तत्र च सर्वं तद्धृदयं खे ॥१९॥

गः प्रथमं रूपं तदकारो मध्यममन्त्यं तदनुस्वारः ।
गमिति हि गणपतिरिह सह नमसा रहसि चतुर्थ्यां हृदि समुपास्यः ॥२०॥

घनगर्जितमिव यच्छ्रुतमभितो मूर्धन्यनुहतमिह गतमन्तः ।

घटयति गीतमिहैव हि चेतः परमिदमनुजानीहि सुचेतः ॥२१॥

ङादय इहखलु यमनुस्वरिताः पवनोऽयं नसि पाप्मनि विद्धः ।
नासिक्यं परिहीय तदन्यं समुपासीत परं हृदि मुख्यम् ॥२२॥

चत्वारि प्रमितानि हि वाचः प्रणवव्याहृतिकानि पदानि ।
चातुर्थ्यन्तु वदन्ति मनुष्यास्त्रीणिगुहायां विदुरिह मुनयः ॥२३॥

छन्दांसि हि यस्मिन्परितस्थुर्यत्परमं पदमक्षरमूचुः ।
छन्दोगानां तदिहोद्गीथस्सोऽयमसौ स्वर इति समुपास्यः ॥२४॥

जपनीयौ सस्वरमुपदिष्टौ स्वरतो योऽसावयमप्युदितौ ।
जानातीत्यनु यत्परिगीतं तत्परमं विदुरिममुद्गीथम् ॥२५॥

झँ झँ झणदिति सुस्वरसहितस्तातीर्ये सवने तु विशिष्टः ।
झङ्कारोऽयं शब्द उपास्यश्चञ्चलचेतस्स्थितये हृद्यः ॥२६॥

ञमङणनानां यस्त्विह निलयः श्राम्यति तत्र चरन्ननिलो यः ।
नासिक्योऽयं सहसा हेयः परमस्त्वन्तर्हृदि समुपेयः ॥२७॥

टङ्कयतीत्ययमिह निजयोगाद्विषयस्तत्र विवेकवियोगात् ।
टङ्कारं परिजनयति सहसा तस्मान्नादरणीयो मनसा ॥२८॥

[1]ठद्वयमन्ते मुनयो ब्रुवते यस्मै कर्म समर्पयितुं ते ।
ठाकारं तदिदं परिवृणुते स्वयमप्यन्तः स्थितमभिमनुते ॥२९॥

डयते यस्त्विह मध्यमयोर्ध्वं सृत्या मूर्धनि सहसाबद्धः ।
डाययति च तं यः खलु बन्धः सोऽयं ह्युड्डीयानकबन्धः ॥३०॥

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[1] ठद्वयं स्वाहाकार इति शाक्तागमः ।

ढक्कां नटराजः किल तारं यद्धि ननाद चतुर्दशवारम् ।
ढक्कानादमयं श्रुतिजालं वर्णसमूहमिदं तदु निखिलम् ॥३१॥

णादि धातौ प्रतितिष्ठति योऽर्थो यस्मिन्पुनरभितिष्ठति सोऽर्थः ।
नाम्नो रूपात्स च परमोऽर्थस्तस्य हि विज्ञाने चरमोऽर्थः ॥३२॥

तपसा ज्ञेयस्तप एवासौ तेजोमय आनन्दमयोऽयम् ।
तत्वन्त्वनयोः परमैकत्वं व्यष्टि समष्ट्यविभेदगृहीतम् ॥३३॥

थमिति हि गीतं यदु छन्दोगैरन्नं पृथिवी चाग्निर्ऋगिति ।
थं त्विदमुद्गीः पूर्वमुपास्यं कामसमृद्ध्यै स्वात्मन उदितम् ॥३४॥

दद्भिश्च दतामस्पर्शनतो रसनायास्तालुनियोजनतः ।
दान्तं तं भुवि सुदृढासनतो विदुरनिशं नयनोन्मीलनतः ॥३५॥

धारणया हृदये स्वनुरक्तो ध्यायति यः परमात्मनि युक्तः ।
धयति निजं सुखरसमभितृप्तो विषये बहिरिह स च सुविरक्तः ॥३६॥

नयनं नयने यदि वा स्मरणे संस्थितमिह गगनेऽन्तःकरणे ।
नन्दति तस्मादयमीक्षणतस्सह मनसैव हि हृदि निश्चलितः ॥३७॥

पवते पतिरिह यः खजनानां ब्रह्मेति श्रुतिसङ्गिरमाणः ।
पञ्चकमपि तं म्रियते परितो देवानामिति परिमर उदितः ॥३८॥

फलमपि परिमरवेत्तारं तं सपदि सपत्नः परितो म्रियते ।
फलति महीयं विगतसपत्ना मानुषमिह सुखमनुभावयितुम् ॥३९॥

बृहतेरर्थानामनुगमतः कारणतो जगतश्चागमतः ।
ब्रह्म हि सकलज्ञं समशक्तं नित्यविशुद्धसुबुद्धविमुक्तम् ॥४०॥

भवति हि यस्मिन्भवतेरर्थो बोधयति हि स च यं परमर्थम् ।
भाभिर्वृणुते दशभिर्निखिलं सोयं सहसा स्वयमिदमचलम् ॥४१॥

मस्तु तृतीया मात्रा प्रणवे तस्य च वाच्यः परमः पुरुषः ।
मात्रात्रितयेनैव हि सोयं पापविमुक्त्यै हृदि समुपास्यः ॥४२॥

यस्मात्सर्वमिदं किल जातं येन पुनः परिजीवति सततम् ।
यत्पुनरभिसंविशति हि नियतं सच्चित्सुखमिह तद्बृहदुदितम् ॥४३॥

रसयति योऽयं परमिह योगादानन्दः सच परमो निगमात् ।
रस इह यस्य यदर्थमभीष्टः सोयमहं रसमय उपदिष्टः ॥४४॥

लक्षणयैव हि जन्मादिकया श्रुत्या निजभावनियामिकया ।
लक्ष्यं तच्छ्रुतमनुभूतिकया ब्रह्मपरं विदुरहमहमिकया ॥४५॥

वक्तुं श्रुतिरपि नैव तमर्थं याथातथ्यं भवति समर्थम् ।
वस्तु परं करणैस्तदगम्यं तपसैव हि केवलमवगम्यम् ॥४६॥

शक्यं न च मनसा ह्यनुमातुं युक्तिशतैरपि वा परिमातुम्।
शरणं ब्रह्मणि निष्ठं गत्वा बन्धविमुक्तो भवति विदित्वा ॥४७॥

षष्टिश्च तथा त्रीणिशतानि यस्य समासेनाहुरहानि।
षट्च ऋतून्वै द्वादशमासानयने च चतुर्विंशतिपक्षान् ॥४८॥

सप्तशतानि च विंशतिमथवा यस्याहोरात्राणि विभागात्।
संवत्सरमिह तं प्रजनानां पतिमाहुरिमं प्रजनयितारम् ॥४९॥

हंसोऽयं षट्शतमिह वारं चैकाधिकविंशतिकसहस्रम्।
हंसं हृदये परमात्मानं रात्रन्दिनमनुजपति प्राणम् ॥५०॥

लसति[1] प्रतिपदमात्मनिवृत्तिर्गायत्रीमजपामनुजपतः।
लष्यति तस्य हृदन्तर्ज्योतिस्तदिदं मनुजस्येह विभूतिः ॥५१॥

क्षरमिह जगदिदमितिपरिदृश्यं यस्मिन्कल्पितमखिलमसत्यम्।
क्षरदिदमनु न क्षरति यदन्ते तत्परमक्षरमुक्तमिदन्ते ॥५२॥

ज्ञप्तिरियं जननीव जनानां ज्ञापयतादितिकृतिमिह विहिताम्।
ज्ञात्वा तत्त्वं जगति जनास्ते जन्मजरामरणैर्नरमन्ते ॥५३॥

ओमथ तत्सदिति प्रथितानि प्राणभृतामिह माङ्गलिकानि।
ओमिति यस्य हि वाचकमुदितं तत्परमं सद्ब्रह्मनिगदितम् ॥४३॥

अद्वैतात्मरसं श्रुतिमूला स्रावयतादियमक्षरमाला।
आत्मरसं भजतामनुकूला दैवरातहृदयान्तरलीला ॥५५॥

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[1] अत्र लळयोरभेदेन ळकारे लः प्रयुक्तः।

प्राचीन समाज में नारी

हरिहर नाथ त्रिपाठी

प्राचीन समाज में नारी के स्थान निर्देश के लिए उस समाज के वैवाहिक सम्बन्ध का विश्लेषण आवश्यक है। इस सम्बन्ध के विवेचन से नारी के स्थान, अधिकार एवं कर्तव्य का सिद्धान्त ज्ञात हो जाता है। वैवाहिक सम्बन्ध के विश्लेषण में यह देखना आवश्यक है कि (क) उसमें उभय पक्ष के लोग किस अनुपात में भाग ले रहे हैं, (ख) विवाह पर प्रतिबन्ध किस रूप में है, (ग) उसमें स्थिरता किस प्रकार की है, (घ) पति पत्नी के सम्बन्ध किस प्रकार के हैं और (ङ) दाम्पत्य के सम्बन्ध स्थापित होने का ढंग क्या है? इनमें से प्रत्येक विवाह की रूप रेखा का नियमन करते हैं। इससे विवाह के इतिहास के साथ नारी के स्थान निर्धारण का प्रश्न ऐतिहासिक रूप में अभिव्यक्त होता है।

इनमें सबसे पहले विवाह में भाग लेने वाले पक्षों पर ध्यान देना आवश्यक है। इसमें (१) एक स्त्री और एक पुरुष भाग लेते हैं, (२) एक या अधिक पुरुष एक स्त्री के साथ वैवाहिक सम्बन्ध स्थिर करते हैं, (३) एक समुदाय के पुरुष एक समुदाय की स्त्रियों से विवाहित होते हैं; इत्यादि ऐसे सम्बन्ध हैं जो उभय पक्ष से भाग लेने वालों की दिशा निर्धारित करते हैं। बहु पत्नी विवाह में सामान्यतया एक पुरुष अनेक स्त्रियों से सम्बन्ध रखता था। इस प्रकार के विवाह में दो पद्धतियां थीं; एक में सभी स्त्रियां समान अधिकार रखती थीं और दूसरे में कुछ प्रधान और कुछ रखैल के रूप में होती थीं। प्रधान को ही सभी वैधानिक अधिकार उपलब्ध थे। बहुपति विवाह के विभिन्न रूप हैं। प्रमाण के लिए तिब्बत में बहु पति विवाह के सम्बन्ध में विशेष नियम यह था कि सभी आपस में भाई होते थे। टोड लोगों की स्त्रियां ज्येष्ठ भाई से विवाहित होती थीं; किन्तु उनका सम्बन्ध अन्य छोटे भाइयों से भी होता था। यहां तक कि किसी के साथ प्रेम सम्बन्ध भी बुरा नहीं माना जाता था। लेकिन अब इस प्रथा का अस्तित्व केवल नायर, खसिया और कज्जाको में छिट-फुट है।[2] अरबों के प्राचीन कबीले में स्त्री बड़े भाई के साथ रात्रि में रहती थी किन्तु अन्य भाई भी उस पर अपना अधिकार समझते थे। इस सम्बन्ध में वेस्टर मार्क ने ३६ उदाहरण दिया है।[3] मेन ने भारत वर्ष में बहु पति विवाह का प्रश्न द्रौपदी तथा अश्विनी कुमार के प्रसंग को लेकर उठाया है। लेकिन हाब्हाउस उसी उद्धरण पर

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[1] प्रिमिटिव और आदि दो शब्द समान हैं। किन्तु अब समाज शास्त्री समाज के प्रारम्भिक रूप को प्रिमिटिव मानने में एक मत नहीं हैं। अतएव विवाद से बँचने के लिए प्राचीन शब्द दिया गया है। लेखक

[2] वेस्टरमार्क। पृ० ४५३

[3] वही। पृ० ४५४

[4] प्रिमिटिव एंड एंशेंट लीगल इंस्टीट्यूशन, में हाब्हाउस का लेख 'वीमेन इन प्रिमिटिव सोसाइटी'। पृ० २३९

अपना विचार व्यक्त किया है कि भारत में इस प्रथा का प्रचलन व्यवहार्य नहीं था। द्रौपदी के प्रश्न पर महाभारत में ही जो विचार किया गया है वह इस बात का द्योतक है कि आर्य पातिव्रत के प्रशंसक थे, उनमें इस प्रथा का अस्तित्व प्रचलित परम्परा के रूप में नहीं था।[१] स्पार्टा में वंश परम्परा न लुप्त हो जाय एतदर्थ अन्य भाई से सम्बन्ध सहन किया जाता था।[२]

सामुदायिक विवाह का प्रचलन मध्य आस्ट्रेलिया केउरबुन में पाया जाता था। डियरी कबीले में वैयक्तिक तथा सामुदायिक दोनो प्रकार के विवाह पाये जाते हैं। इनमें मुख्य पति विशेषाधिकारी होता है।[3] इस प्रकार के विवाह का विशेष महत्व उस समय स्पष्ट होता है जिस समय एक आस्ट्रेलिया निवासी एक पिता नहीं अपितु पितृसमुदाय रखता है। कुछ समाज शास्त्रियों का कहना है कि विशिष्ट जातियों में भी जहां विधवा या विधुर विवाह इस रूप में विकसित हैं कि विधवा पति के भाई या विधुर पत्नी की बहन आदि से विवाह कर लेता है वहां उसे सामुदायिक विवाह का परवर्ती रूप माना गया है। इस समय इन कबीलों में बहु पति तथा बहु पत्नी दोनों विवाहों का सम्मिश्रण चल रहा है। साथ ही उनके आधुनिक वैवाहिक सम्बन्ध का विश्लेषण भी प्राचीन रूप को दृष्टि में ही रख कर किया जा सकता है।

जहाँ मातृ परम्परा का सम्बन्ध दृढ़ नहीं रहता वहाँ रक्त सांकर्य और वैवाहिक दृढ़ता का अभाव रहता है। डाक्टर वेस्टर मार्क ने इस सम्बन्ध में ३१ प्रमाण दिये हैं[४]। उनका कहना है कि विभिन्न स्त्रियों के साथ सम्बद्ध रहते हुए वैवाहिक सम्बन्ध ज्यों का त्यों अपने रूप में स्थिर रहता है। किन्तु अन्य समाज शास्त्री इस बात का निषेध करते हैं। उनके अनुसार रखैलों तथा यौन सम्बन्ध मात्र के लिए स्थापित सम्बन्ध को विवाह कथमपि नहीं कहा जा सकता[५]।

हाब्हाउस के अनुसार ढीले बन्धन के वैवाहिक सम्बन्ध असभ्य और बर्बर जातियों में होते हैं[६]। स्पार्टा और तिब्बत को छोड़ कर किसी सभ्य देश में बहुपति विवाह की प्रथा नहीं पायी जाती। एक पत्नी व्रत तथा कुछ सामान्य अपवादों में बहु पत्नी विवाह सभ्यता के विकास के साथ विकसित होते रहते हैं। साथ ही हम यह भी देखते हैं कि कठोर एक पत्नी व्रत का भी सिद्धान्त असभ्य जातियों के व्यवहार में पाया जाता है। अंडमान के लोग इस प्रमाण में रखे जा सकते हैं। कुछ ऐसी जातियाँ हैं जहाँ कुछ कारणों

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[१] मेन। हिन्दू ला एंड युसेज, पृ० ६५, चतुर्थ संस्करण

[२] ग्रोटे। द्वितीय जिल्द, २ अध्याय ६, पृ० ५२०

[3] ए० डब्लू० हाविट। दि अर्गनाइजेशन आफ आस्ट्रेलियन ट्राइब्स प्रथम जिल्द, पृ० १२४

[४] वेस्टरमार्क। पृ० ५२, ५५

[५] इसके लिए उदाहरण द्रष्टव्य, ट्राइब्स आफ कैलिफोर्निया, पृ० २३८

[६] हाब्हाउस। वीमेन इन प्रिमिटिव सोसाइटी, पृ० २४२

[७] कोहलर ने माना है कि प्रथम पत्नी के स्वीकार करने पर ही द्वितीय विवाह सम्भव था। पृ० ३४२

पर दूसरी पत्नी के साथ सम्बन्ध रखने का नियम है वहां तलाक के नियमों का प्रचलन पाया जाता है। ओसेनिया में इस प्रकार का नियम है। न्यू गिनी के डोरियन में न तो बहु पत्नी विवाह का प्रचलन है न तो रखैलों की मान्यता। भारत की पहाड़ी जातियों में कहीं बहु पत्नी विवाह की मान्यता है कहीं नहीं भी है। करेन केवल एक पत्नी रखते हैं। सन्थाल कुछ कारणों पर अन्य विवाह भी करते हैं किन्तु उसे पूर्व स्त्री की समता नहीं मिलती। द्वितीय स्त्री के आने पर तलाक आवश्यक है। कुकि, कारा कंगुत एवं उत्तरी अमेरिका के भारतीय इनमें तलाक के साथ एक पत्नि-व्रत का नियम है। निग्रो और बेन्तू में बहुपत्निविवाह होता है[1]।

एक पत्नी या बहुपत्निविवाह के समान नियमों में भेद भी है। जहां बहुपत्नि-विवाह की परम्परा है वहाँ ऐसे भी लोग हैं जिन्हें एक पत्नी का भी अभाव रहता है। अर्थात् बहुपत्निविवाह धन, ऐश्वर्य इत्यादि की बात कबीलों में भी चलती है। बहुपत्नि-विवाह सम्पत्तिशालियों के लिए ही व्यवहार्य माना जाता है। इस लिए गरीब कबीलों में बहुपत्निविवाह का सम्बन्ध अधिक चलता है। एक पत्निविवाह के लिए दो शब्द दिए जा सकते हैं, नैतिक एकपत्निव्रत और व्यावहारिक एकपत्निव्रत। नैतिक एकपत्निव्रत से तात्पर्य यह है कि धनी कबीले भी एक पत्नि व्रत धारण कर सकते हैं, जब कि कहा जाता है कि गरीबी के कारण एक पत्नि व्रत की परम्परा पायी जाती है। जर्मनी के कबीले धनी थे अतएव वहां बहुपत्नि विवाह और इराक के कबीले गरीब थे अतएव उनमें एक पत्नि विवाह की परम्परा पायी जाती है[2]। लेकिन भारत तथा मलाया के धनी कबीलों में एक पत्नी व्रत के कड़े नियम पाये जाते हैं[3]।

विवाह के इन सम्बन्धों के बाद हमे वैवाहिक निषेध पर भी ध्यान देना चाहिए। प्रत्येक समाज में पति-पत्नि के चुनाव सामान्य या विशेष, दृढ़ या सरल निषेध से प्रतिबद्ध रहा करते हैं। इन निषेधों की उत्पत्ति और आधार बड़े मनोरंजक हैं जिन पर विशेष रूप से प्रमाण प्रस्तुत करना आवश्यक नहीं है। कहीं कबीले के बाहर विवाह के असगोत्र परक नियम कठोरता से पाये जाते हैं; जैसे भारतीय विवाहों की वर्णपरकता और जिप्सियों की कबीले के बाहर दूसरे विशेष कबीले के साथ वैवाहिक सम्बन्ध[4]। भारत में इस परम्परा का प्रचलन आज भी हो रहा है। आधार में भेद के साथ आधुनिक सभ्य जातियों में भी इस प्रकार के सम्बन्ध पाये जा रहे हैं। संयुक्त राज्य अमेरिका में २२ राज्य ऐसे है जहां निग्रो के साथ, ४ राज्य में भारतीयों के साथ और अन्य ४ राज्यों में मंगोलियन के साथ वैवाहिक सम्बन्ध निषिद्ध हैं[5]। कहीं-कहीं इसका स्तर साम्पत्तिक भी हो जाता है। जर्मन विधि के अनुसार राज्य परिवार के लोगों का वैवाहिक सम्बन्ध गरीब परिवार के साथ होना

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[1] पावर्स। पृ० २२
[2] लीग आफ ईराक पृ० ३२४
[3] वेस्टर मार्क। पृ० ४३५
[4] पोस्ट। पृ० ३३
[5] पार्ली। पेपर्स मिसेल, नं० २, १८९४, पृ० १५५

अयोग्यता का सूचक था[1]। कुछ जातियों में 'टोटम' के आधार पर निषेध चलता था। उत्तरी अमेरिका के भारतीय, आस्ट्रेलिया के कुछ कबीले, नाग[2] सोमाली[3] आदि जातियों में अपने समुदाय में भी विवाह के निषेध विहित हैं। कहीं पीढ़ियों का निषेध चलता है[4]।

यदि अपने कबीले में ही 'टोटम' के आधार पर वैवाहिक नियम चल रहे हैं और कुटुम्ब मातृ सत्ताक चल रहा है तो प्रकारान्तर से भाई और बहन वैवाहिक बन्धन में आ जाते हैं। तार्किक दृष्टि से देखने पर यही बात कन्या और पिता के बीच उत्पन्न हो जाती है। 'टोटम' के निषेध से इतना तो पूर्ण स्पष्ट है कि जितने भी सम्बन्ध होंगे वह सब निकट सम्बन्धी ही होंगे। न्यू ब्रिटेन में इस परम्परा को स्पष्ट रूप से देखा जा सकता है[5]। पिता और पुत्री, भ्राता और भगिनी के विवाह के प्रमाण अन्यत्र भी पाये जाते हैं[6]। यहां तक कि माता के साथ वैवाहिक सम्बन्ध प्रकारान्तर से कहीं कहीं पाया जाता है। इससे स्वच्छन्द विवाह का प्रसार होता है। युलिटास, मिस्र और पारस के राजघरानों में कौटुम्बिक विवाह इसी आधार पर होने लगे थे।[7]

इससे तीन निष्कर्ष प्राप्त होते हैं। (१) व्यक्ति के अपने वैवाहिक सम्बन्ध किसी न किसी निकटतम सम्पर्क में ही व्यवस्थित रखने की स्थिति, (२) विवाह में रक्त सम्बन्ध की स्थिति, और (३) अन्य कुटुम्बों के वैवाहिक सम्बन्ध की स्थिति।

अपने गोत्र या कबीले से बाहर वैवाहिक समबन्ध से कुछ सामान्य विशेषताएं सामने आती हैं। (१) ग्राम तथा कुटुम्ब के साथ निकटतम विवाहों पर प्रतिबन्ध उपस्थित हो जाता है। निकट सम्बन्धों के शारीरिक प्रभाव की बात नकारात्मक तथा सकारात्मक उभय पक्ष में उपस्थित होती है।[8] (२) सामाजिक रूप के द्वारा अनेक समुदाय एक बन्धन में बंध जाते हैं। (३) नैतिक तथा आचारिक व्यवहारों का विकास होता है। यद्यपि इन निषेधों के उपरान्त घटनाएं घटित होती रहती हैं तथापि उनका सम्बन्ध मानवीय प्रवृत्ति की उस परम्परा से है जो अनवधानता के रूप में सर्वत्र विद्यमान है।

अब हमें विवाह की स्थिरता पर भी विचार करना चाहिए। इसके लिए हम देखते हैं कि सामान्यतया दो प्रकार की स्थिति देखी जाती है। कुछ निम्न जातियां हैं जहां वैवाहिक सम्बन्ध बहुत सरलता से भंग किये जाते हैं। कुछ जातियों में वैवाहिक नियमों में बड़ी कठोरता रहती है। उनको भंग करना कठिन हो जाता है। तलाक के नियम में देखा जाता है कि (अ) दोनो पक्षों में किसी एक पक्ष के द्वारा सम्पन्न किया जा सकता है।

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[1] वेस्टर मार्क। पृ० ३७३
[2] पोस्ट। पृ० ३८३
[3] वही। पृ० ४७८
[4] एलिस। अरबिया स्पीकिंग पीपुल्स पृ० १७६
[5] डेंक्स। जे० ए० आई०, पृ० २८३
[6] रेक्लस। ६५
[7] वेस्टर मार्क, पृ० २६०। मैक्समूलर, पृ० ७, ८
[8] ह्यूस। मैरेज आफ नियर किन, अध्याय ८

(ब) दोनो पक्षों की स्वीकृति पर तलाक सम्भव हो सकता है। (स) न्यायालय, परिवार, कुटुम्ब, तथा पति पत्नी के निर्णय पर तलाक सम्पन्न हो जाता है। (द) कुछ सामान्य स्थितियों में दोनों पक्षों द्वारा इसका प्रकाश किया जा सकता है। प्रमाण के लिए कुछ सामान्य स्थितियां इस प्रकार हैं। (१) दोनो पक्षों में किसी को विवाहगत दंड दिया गया हो। (२) विवाह गत कोई दोष ऐसा हो जिनका प्रकाश करना आवश्यक हो। (३) विवाह के नियमों में किसी प्रकार की अपूर्णता रही हो।

सभ्य समाज हो या असभ्य समाज, तलाक पति पत्नी के सामान्य समझौते या विशेष कारण पर ही सम्भव हो सकता है। जब पति-शक्ति का विकसित रूप सामने आने लगा तो तलाक एक पक्षीय एवं कट्टरता के साथ होने लगा। इसके पूर्व पत्नी भी अपनी तलाक शक्ति का समान स्तरीय प्रयोग कर सकती थी[१]। पुरुष शक्ति की विकसित स्थिति में ही रोमन अभिमान पूर्वक कह सकते थे कि उनके यहाँ तलाक नहीं था। वास्तविकता यह थी कि उस समय तक नारी अपना स्वत्व पुरुष में खो चुकी थी। ऐसा ही रूप हेब्रू संस्कृति में भी हो गया था कि केवल कागज के टुकड़े पर लिख कर दे देने मात्र से नारी तलाक सम्भव मान लिया जाता था। मोरिश कबीले, जो सहारा में थे, तथा होटेंटोट लोगों से सन्तान की परिचर्या या कुछ आवश्यक सामग्री देकर जान छुड़ायी जा सकती थी[२]। प्राय: सर्वत्र यह नियम था कि त्यक्त पुरुष तो विवाह कर सकता था किन्तु त्यक्ता स्त्री विवाह नहीं कर सकती थी। लेकिन सभ्यता के प्रथम चरण में कुछ अपवादों को छोड़ कर तलाक में पातिव्रत की स्वतंत्रता थी। किन्तु जहाँ द्रव्य के विनिमय में स्त्री आती थी वहाँ उस समय में भी तलाक एक पक्षीय हो जाता था[३]।

प्राचीन असभ्य समाज में चार प्रकार से स्त्री प्राप्त की जा सकती थी, बलात अपहरण, क्रय, सेवा और स्वीकृति। बलात अपहृत कन्याओं के साथ कुटुम्ब की सभी कन्याएँ नहीं ग्राह्य होती थी[४]। मलेन तथा अन्य समाज शास्त्रियों का विचार था कि अपहरण की परम्परा प्राचीन काल में सामान्य थी किन्तु अब यह विचार त्याज्य हो गया है। नैतिकता का सम्बन्ध इस प्रकार के भी वैवाहिक सम्बन्धों में लगा रहता था। बलात अपहरण की अपेक्षा क्रय पूर्वक विवाह की परम्परा अधिक पायी जाती थी। लेकिन इस अवस्था में नारी सम्पत्ति के रूप में हो गयी थी। विक्रेता का स्वत्व सर्वविध बन जाता था। विक्रय का स्तर भी बदलता रहता था इसके साथ आचार शास्त्र का भी सम्बन्ध लगा दिया गया था, जिसकी प्रतिक्रिया में दहेज का विस्तार कहा जाता है। कभी-कभी क्रय विक्रय उभयात्मक इस रूप में हो जाता था कि दोनों कुटुम्ब के लोगों में विक्रय के स्थान पर कन्या विनिमय हो जाता था[६]।

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[१] पोस्ट। पृ० ११७

[२] वही। पृ० ४३४

[३] हार्वर्ड। ए हिस्ट्री आफ मेट्रीमोनियल इंस्टीटयशून्स। पृ० २२४, २२५

[४] हार्वर्ड। पृ० २३१

[५] वही। पृ० २३१

[६] वही। पृ० १६५, १६६

जब पति स्त्री को प्राप्त करने के लिए मूल्य नहीं दे पाता था तब उसके बदले में वह उसकी भृत्यता स्वीकार कर लेता था। यह विधि अब भी पायी जाती है[१]। इस प्रकार के विवाह का मूलाधार आर्थिक है; क्यों कि पुरुष जब सम्पत्ति से स्त्री को खरीद नहीं सकता तभी इस विधि का पालन करना पड़ता था। सभी समाजों में प्रायः उच्चकोटि की वैवाहिक स्थिति 'स्वीकृति' मानी जाती है। इसमें दोनों पक्ष अपने अधिकारों का वर्गीकरण स्वयं कर लेते हैं। वेस्टर मार्क, पोस्ट आदि विद्वानों ने जो प्रमाण प्रस्तुत किया है उनमें एक बात अवश्य पायी जाती है कि अभिभावकों की भी स्वीकृति अनिवार्य थी[२]। साथ ही यह भी ध्यान देने योग्य बात है कि कन्या की स्वीकृति को अभिभावक बदल भी नहीं सकते थे।

कौटुम्बिक विकास के साथ विवाह के तीन चरण स्पष्ट होते हैं। प्रथम स्तर पर पति, पत्नी और सन्तान अपने सम्बन्ध को स्थिर नहीं कर पाते। द्वितीय स्तर पर पति मातृसत्ताक परम्परा के स्थान पर स्वयं गृहपति बन जाता है और पत्नी घर की दासी स्वरूपा। तृतीय चरण में नैतिकता आदि का विकास हो जाता है इसमें दम्पति अपने निजी व्यक्तित्व की सर्वविध सुरक्षा कर पाते हैं। किन्तु यह सम्बन्ध केवल अधिक अंश में काल्पनिक ही रह जाता है, वास्तविकता कम रह जाती है। प्रारम्भिक स्तर पर मातृ सत्ता और मातृ अधिकार के रूप इस प्रकार थे कि उसे नारी जाति के लिए स्वर्ण युग कहा जा सकता है किन्तु बाद की पितृसत्ताक परम्परा ने उसका ध्वंस कर दिया। इस स्थान पर एक बात बड़े मजे की यह है कि प्रारम्भिक मातृसत्ताक परम्परा ने अपनेअस्तित्व की रक्षा पति अधिकार से करना चाहा। इस अवस्था में उसने अपने पूर्व कुटुम्ब से समझौता भी किया किन्तु असफल रही। प्रायः देखा जाता है कि मातृसत्ताक परम्परा में स्त्री के भाई के अधिकार का प्रवेश हो गया। स्त्री अपने भाई को अपने स्थान पर, प्रबन्ध के लिए नियुक्त करती है किन्तु भाई उस पर स्वयं शासक बनने लगता है। फलतः स्त्री भाई की दासता में जकड़ उठती है और पुरुष बन्धन से मुक्त नहीं हो पाती।

मातृसत्ताक तथा पितृसत्ताक परम्परा के अध्ययन से स्त्री के स्थान निर्धारण में सहायता मिलती है। इसके तुलनात्मक अध्ययन करने में इस बात पर ध्यान रखना चाहिए कि मातृसत्ता में पुरुष तथा पितृसत्ता में स्त्री की क्या स्थिति रहती है? मातृसत्ता में स्त्री अपने कुटुम्ब की सदस्या बनी रहती है। पितृ सत्ता में उसका सम्बन्ध कुटुम्ब से विच्छिन्न हो जाता है और उसमें मात्र पितृशक्ति की सुरक्षा और वृद्धि परिलक्षित होती है किन्तु अपर पक्ष में उक्त अधिकार केवल पुरुष को प्राप्त होते हैं। केवल उसके अभिभावक ही कुछ अधिकार रखते हैं जिनका प्रयोग केवल उस समय किया जा सकता है जब पतिगृह में उसके साथ अत्याचार किया जाता हो[3]। इसका परिणाम यह था कि यदि स्त्री सम्पत्ति शीला है तो पति उसका दास रूप होता था। यदि वह निर्धन है तो स्वभावतः

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१ वेस्टर मार्क। ह्यूमन मैरेज, पृ० ३९०

२ वेस्टर मार्क। पृ० २१५, पोस्ट। पृ० ३६४, ३७१

3 वेत्ज। १४४, मारसडन। हिस्ट्री आफ सुमात्रा, पृ० २२०

उसका स्वामी होता था। इस बात को आज के कुछ सभ्य समाजों में भी देखा जा सकता है। प्राचीन रोम तथा सुदूर पूर्व की जातियों में अब भी देखा जाता है कि व्यवहार में स्त्री का स्वामित्व स्वयं की उसकी अपनी स्थिति पर निर्भर करता है। यह सत्य माना जाय कि मातृ वंश-परम्परा में नारी के अधिकार अधिक सुरक्षित थे किन्तु वास्तविकता व्यवहार के समय और ही हो जाती थी। कहा जाता है कि नायर जाति में कभी स्त्रियाँ स्वयं अपने पति का चुनाव करती थीं और चुनाव के बाद अपने घर ले जाती थीं। सम्पत्ति पर उनका स्वामित्व होता था। सन्तान उनकी परम्परा में मानी जाती थी। तलाक का अधिकार उन्हीं को था। फलतः पति पत्नी का दास होता था[१]। प्रायः भाई बहन अपने घर पास पास बनाते थे और उनके सम्बन्ध व्यवहार में पति पत्नी जैसे होते थे। इस स्थिति में परिवार का संगठन इस रूप में विकसित होता था कि स्त्री उस संगठन की धुरी हो गयी। इससे उसे महत्वपूर्ण अधिकार भी प्राप्त हो गये। लेकिन इसके साथ यह भी अनिवार्य नियम लगा था कि जिस सम्पत्ति को स्त्री उत्तराधिकृत करती थी उसकी व्यवस्था भाई या अन्य उस परिवार का ही व्यक्ति करता था और सम्पत्ति का रूप सामूहिक हो जाता था। फलतः इस स्थिति में स्त्री अपने पति की दासता से तो मुक्त होती थी किन्तु भाई की दासता में जकड़ उठती थी।

इसी प्रकार की स्थिति कुछ अंशों में उत्तरी अमेरिका की आदि जातियों में पायी जाती है। यहां स्त्रियों को राजनीतिक अधिकार इतने अधिक थे जो आज की सभ्य जातियों में नहीं पाये जा सकते। बन्दियों को क्षमा दान तक का अधिकार उनके लिए सुरक्षित था। इराक की आदि जातियों के हाथ मुखिया की नियुक्ति के भी अधिकार थे।[२] किन्तु कहीं कहीं इस कबीले में स्त्री दास तुल्य भी थी।[3] उत्तरी अमेरिका के भारतीयों के यहां सम्पत्ति यद्यपि स्त्रियों के माध्यम से उत्तराधिकृत होती थी किन्तु जहां तक स्वामित्व का प्रश्न था वह पुरुष मे ही समाविष्ट था।[४] भारत की पूर्वोत्तर सीमा की कुछ जातिया हैं जहां पति, पत्नी और उसकी मां का दास होता है।[५] अन्य ऐसी जातियों का पता लगता है जहां स्त्रियां पुरुष कुटुम्ब की सदस्या रह जाती है। पति परम्परा के देवता, गोत्र आदि सभी कुछ उसके हो जाते हैं उसके पूर्व कुटम्ब के कोई भी वैधानिक सम्बन्ध शेष नहीं रह जाते। मातृ सत्ता में सन्तान का नाम करण माता से चलता है। तलाक में वे मातृ वंश के समझे जाते हैं। मातृ वंश परम्परा के लोग सन्तान के संरक्षक बनते थे। भाई स्वाभाविक अभिभावक माना जाता था। यहां तक कि वह पति से उसकी यथाअवसर रक्षा करता था। पितृ सत्ता के अवसर पर उक्त सम्बन्ध का विपर्यास हो जाता था। पितृ परम्परा की कठोरता पर नियन्त्रण रखने के लिए एक समझौता हुआ-सा प्रतीत होता है जिसमें मातृ कुटुम्ब के लोग मातृ शक्ति की रक्षा करते-

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[१] रेक्लस। प्रिमिटिव फाक, पृ० १५६, १५८

[२] मार्गन। हाउस एंड हाउस लाइफ आफ अमेरिकन अबारिजिन्स, पृ० ६५

[3] मार्गन। लीग आफ इराक, पृ० ३२३

[४] वेल्ज। ३।२१२९

[५] वही। ३।३२७।३३३

देखे गये ।[1] विशेषतः भाई अभिभावक बन जाता था इसी परम्परा में भाई बहन का वैवाहिक सम्बन्ध का यत्र-तत्र विकास भी समाज शास्त्री मान लेते हैं। पितृ सत्ता का विकास इतिहास में कब हुआ कहना कठिन है किन्तु एक समय प्राचीन सभी समाजों में इसकी सत्ता थी। प्रोफेसर टाईलर के अनुसार अपहरण के माध्यम से विवाह परम्परा ने मातृ सत्ता को समाप्त कर दिया, यद्यपि कन्या विक्रय के युग से उसका प्रारूप उदित हो रहा था।[2] लेकिन जिस रूप में मातृ सत्ता का रूप समग्र प्राचीन समाज में पाया जाता है उस रूप में विक्रय प्रथा सार्वजनीन नहीं कही जा सकती।

प्रस्तुत विश्लेषण के साथ नारी का प्राचीन समाज में क्या रूप था स्पष्ट हो जाता है। यद्यपि यह सत्य है कि मातृ सत्ताक परम्परा में स्त्री के अधिकार स्वस्थ थे किन्तु यह सत्य अन्तिम नहीं है। कैरबि में मातृसत्ताक कुटुम्ब की सत्ता पायी जाती है किन्तु स्त्री को यह अधिकार नहीं था कि वह तलाक दे सके और सम्पत्ति तथा सन्तान की स्वामिनी बन सके। उत्तरी अमेरिका के भारतीयों में भी यही परम्परा रही[3]। मेलेनेशिया में मातृ सत्ता का उदय पूर्ण रूप में हुआ किन्तु कुटुम्ब का प्रधान पुरुष ही होता है। सम्पत्ति और सरकार पर उसी का स्वामित्व मान्य रहता है[4]। कुछ समाजशास्त्री इस बात पर जोर देते हैं कि जब पुरुष स्त्री को शुल्क देकर खरीद नहीं सकता तो वह सेवा के द्वारा पत्नी की प्राप्ति में स्त्री के अधिकार क्षेत्र में रहता है। किन्तु ध्यान देने की बात यह है कि वह स्त्री की सेवा नही करता न तो उसका दास होता है अपितु उस अवस्था में वह कुटुम्ब का दास और सेवक होता है।

मलाया में यह नियम दो रूप में व्यक्त होता है। प्रथम में पुरुष स्त्री परिवार में स्वयं को बेचता है और वहीं जीवन यापन करता है। सन्तान मातृ वंश की मानी जाती। तलाक का अधिकार केवल स्त्री को होता है। ईस अवस्था में मातृशक्ति का विकास परिलक्षित होता है किन्तु अपर पक्ष में स्त्री उसी प्रकार दासी बन जाती थी जिस प्रकार अन्य कबीलों में। अन्यत्र जहाँ कहीं भी स्त्री के गौरव पूर्ण स्थान दिखायी पड़ते हैं वहाँ स्पष्ट है कि स्त्री की महत्ता स्वयं की आर्थिक स्थिति या उसकी सामाजिक स्थिति पर रही हो। अन्यथा यह भी रहा हो कि उस समाज में कन्या विक्रय के नियम रहे हों और पति शुल्क देने में असमर्थ रहा हो[5]। वैधानिक स्थितियों के अध्ययन से पता चलता है कि स्त्री के वैधानिक अधिकार सामान्यतया न्यून थे। प्राप्त अधिकारों के प्रयोग में भी बाधाएँ थीं जिनमें उनकी सामाजिक स्थिति ही कारण थी[6]। अपहरण, विक्रय तथा विनिमय आदि के

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[1] विनो ग्रोडफ। ग्रोथ आफ दि मैनर, पृ० ११, १२
[2] टाईलर। जे० ए० आई० १८, २५९
[3] वेत्ज। ३८२
[4] कार्ड्रिगटन। पृ० 'जे० ए० आई०' १८, ३०९
राट्जेल। दि हिस्ट्री आफ मैनकाईंड, ३३४
[5] वेस्टर मार्क। सोशियालिजिकल पेपर्स, पृ० १५१
[6] वेस्टर मार्क। दि ओरिजिन एण्ड डेवलपमेंट आफ मारल आइडियाज, पृ० ६४६

नियम इस बात के प्रमाण हैं कि स्त्री अधिकार पुरुषों के समान नहीं थे। स्त्री की सम्पत्ति उसकी स्वयं की न होकर या तो पति की होती थी या अन्य अभिभावकों की। यहाँ तक कि उसका शरीर भी सम्पत्ति के रूप में उसके पति या अभिभावकों की सम्पत्ति हो जाता था। पवित्रता के नियम नारी समाज पर इस प्रकार लदे थे कि यदि पति अन्य किसी के साथ अपनी स्त्री को भोग करते पा जाय तो उसकी हत्या भी कर सकता और ऐसा करना कबीले के नियमानुसार वैध था। किन्तु वही पति आये हुए अतिथि की सेवा में पत्नी को व्यभिचार के लिए प्रस्तुत कर सकता था और वह कबीले के नियम के अनुसार शिष्टाचार था। पवित्रता का नियम सर्वथा एकांगी था। इनके साथ धार्मिक नियमों का भी ऐसा सम्बन्ध लगा दिया गया था कि स्त्री कुछ कबीलों में भाई, पिता और पुत्र को छोड़ कर किसी के साथ सम्बन्ध के लिए बाध्य की जा सकती थी[२]।

इस प्रकार स्त्री सम्बन्ध शक्तिवादी सिद्धान्त का उदय होता था जिससे स्त्री का अपहरण आदि के साथ कबीलों में उनके मांग और पूर्ति के सिद्धान्तानुसार क्रय-विक्रय भी होता था। स्त्रियों के चुनाव आर्थिक कारणों का भी महत्व पूर्ण स्तर बनने लगता था[3]। इतना अवश्य था कि जहाँ मातृसत्ता का उदय हुआ था वहां अपेक्षाकृत स्त्रियों को अधिक अधिकार प्राप्त थे। पितृसत्ताक परम्परा में स्त्रियों के अधिकार न्यून थे। इतना और ध्यान में रखना चाहिए कि दोनों वंश परम्परा में पुरुष के अधिकार विधान तथा अर्थ, राजनीति, सामाजिक स्थिति में अधिक थे। साम्य संघ के अस्तित्व की कल्पना आदिम समाज में करने वाले समाज शास्त्रियों को इस तथ्य पर ध्यान देना चाहिए।

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[१] वेस्टर मार्क। पृ० ७३ ७४

[२] स्पेंसर एण्ड गिलेन। पृ० ९७

[३] वेस्टर मार्क। पृ १५९

THE PLOT STRUCTURE IN SHAKESPEARE

G. D. SHASTRI

The drama is a scenic representation of action. The whole story of the play is enacted on the stage by means of visual performances. Stage realism plays an all important role in creating a sense of make-believe. Even otherwise, the play moves on scene by scene unfolding the nature of the plot, the action in flow leading from event to event on to the final conclusion. Nowhere in the course of the entire story, does it anywhere stop for any kind of direct or indirect digression on the part of the author who has to keep himself sedulously away from it. This then constitutes the essential characteristic of the drama, and distinguishes it from the novel or the narrative. To construct the play is then to piece together scenes or events in a relationship of organic growth, that is to say, scenes are so constituted that their sequence and succession seems natural and causal. Since the dramatic story is never narrated but only visualised, its compactness is the very *sine qua non* of its existence. It can never afford any looseness, digression and superfluity. Each scene must form a link in the chain of events that go to make the plot. No dramatist can, therefore, afford to neglect the proper construction of plot on which alone rests the strength of the play—its quality to charm.

The essence of the dramatic plot is its mobility, its capacity to unwind itself in the occurrences of the story. In other words, the scences should display the action that the story involves. And since the natural mode of narration is not available to the dramatist to start the story, he has to be cautious not only in the selection of his details but also in their proper concatenation. The opening scene becomes more important, since it is at this place that the ball is set rolling. Much would depend on it. The dramatic story has to be pieced together from the various scenes constituting the play and necessity of dramatic

art cuts and keeps these scenes into separate acts. The division of the play into acts is an inescapable result of the nature of the dramatic form. The story must begin in such a manner that it is self explained, and should possess the power of growth. Clash of interests, opposition of forces, appearance of complications, their flow and direction followed by denouement and end, are inevitable features of the play, and cause continuous excitement to the spectator owing to the manner his curiosity is provoked and satisfied. The strength of the drama is in this *creation of curiosity*. The five-fold division of the play correspond, to the five stages of the reader's curiosity viz., arousing of interest, its growth, counter interest, the clash and the end. The interest starts with the commencement of the story on the part of the reader with his awareness of something happening to certain people. The exposition is by its very nature a difficult undertaking. It should initiate the reader into the mystery of the play without seeming to do so openly or directly. The art involved requires the communication to be made expeditiously, economically and naturally. Direct and straight forward talks between characters in a manner that the seeds of action are laid to fructify in a sequence all predetermined constitute the links of the drama. The development of the story from scene to scene and its movement to its ultimate sequel should be characterised by a naturalness of organic necessity, which is only another name for dramatic logic. The drama is more logical than life, since the dramatist has more power over his characters than men have over their lives. As a matter of fact, while we are predisposed to take things for granted in life even where we are not satisfied with their occurrences, no such acquiescence is tolerated in literature where the writer is expected to be logical and consistent. Hence, it happens that in drama, things are brought about in a mechanical way to follow a particular course. In no form of literary art, is this persistence of logical and mechanical interflow of events so smoothfully preserved as in the drama. And it is here that a great genius can show what art and insight can achieve.

Shakespeare's mastery in plot-construction reveals his remarkable skill with which he not only keeps the interest of the reader ever alive but also compels the event to go a certain way. Of course, in regard to the latter, there are occasions when the necessity of giving a particular end to any story makes him wind up even contrary to what the trend of the story would indicate. Shakespeare's openings are marvellous, executions effective, natural and direct. The spectator who has no knowledge of the story beholds a few figures on the stage, engaged in conversation. He must find out for himself what they are and to what purpose gathered. His interest in their fortune will depend on what sympathetic understanding they can produce on his mind by their own words and deeds. That is the essence of scenic skill. The foundations of the dramatic edifice are laid in the opening scenes, and the only law that governs the layout of the plot is that the story should unfold itself naturally, without the loss of 'dramatic excitement' or thrill.

The details of the plot have, therefore, to be arranged in a manner that keeps the interest of the reader ever on the alert. He should not be allowed to take things for granted. Shakespeare knew and employed this principle with the greatest skill and effect. His starting scenes are marvellous in design and execution. No superfluity or non-essential matter is allowed to impose itself here in the beginning.

The two-fold purpose of the opening scene seems to give the spectator an idea of what the story that he has come to see is, and to prepare his mind to receive it in its entirety in the most satisfactory manner. The scene is preparatory in purpose, not only in the sense that it prepares the ground for the full development of the plot but also, and in a more real sense, for the way in which it creates a feeling in the mind of the spectator of satisfaction and fulfilment. The twin processes go side by side. The dramatist, as an objective craftsman is concerened with plot construction from the point of view of effective unfoldment of the story, but as an artist seeking an aesthetic end is no less concerned to produce on the mind of

the spectator an impression of fulfilled delight. The latter very often follows from a realisation on the part of the reader that the dramatist has done his job well.

The plot in the drama is only an arrangement of incidents involved in the story. The piecing together of these incidents in scenes is the plot. Since the whole story has to be so communicated and within a specified time limit there is hardly any superfluous matter. Shakespeare's skill in this respect is unerring. He begins by making his initial scenes striking, impressive and self-revealing. They are struck according to the needs and exigencies of the story. Tragedies begin by striking a note of horror, surprise, or some kind of exciting atmosphere with which to introduce the main character and the purpose of the story. Such is the beginning of *Macbeth*- the tragedy of a man's fall from realised greatness to terrible ruin through uncontrolled and degrading ambition. The terrible lapse of human character, the blinding passion of ambition making man forget his basic duties in life, and the appalling spectacle of a man of action being thrown off his moral hinge by inordinate desires, all have been very significantly preluded by the briefest scene in Shakespearean literature, that is like a flash of lightning in a dark sombre landscape, revealing as much as hiding the hideousness of the thing that it is.

The purpose of the opening scenes is to provide the reader with as much necessary data as would help him to follow with ease the ensuing action of the story. The dramatist's skill lies in the natural way with which this information is conveyed. Shakespeare's instinctive skill is unerring in the naturalness of his dramatic commencements. The entire play is a progressive move through a set path in which the end is conditioned by the previous links. The action moves in a direction conditioned by circumstances arising in the course of development. To arrange these circumstances in the order of a set design—that's the task of the plot-maker. *Macbeth's* is a simple story, such as has often been enacted on the stage of the world by ambitious men who have not hesitated to get into power by

treachery and treason. The purpose of the play is not merely to repeat such a story. On the other hand, the dramatist is concerened with the study of the way in which a man like Macbeth, acting on an impulse at once dangerous and ruinous for him, succeeds for a time only to fall for ever. As the play is, the fall of the man is inherent in his own character. The tragedy arises not on account of the fall—which is just and deserving, but on account of the potential frustation of the good that is in Macbeth. Macbeth should not have fallen, though he falls and falls terribly. Good men are not much different from bad men, except in motives and deeds. Macbeth might have continued as a capable, respected and popular figure in society, had he used well his chance. But his lust for power stood in his way. Even his 'prudence' could not save him, because backed by his own ambition his evil nature could not resist the encouragement that he received from his wife towards evil. That was the tragedy of his life. The plot in Macbeth is concerned with making this purpose clear. Macbeth's internal evil comes to the fore early in the play. No reader misses this. The witches only call it forth and give it a visible shape. How far would Macbeth resist this temptation—that is the question which every reader asks to himself. And it is not very long when he becomes convinced that Macbeth has not got the necessary strength to resist his own weakness. A weak man like Macbeth is further weakened by the exhortations and taunts of his own wife. The whole of the first Act is a revelation of this conflict in Macbeth's mind-between the feeble good in him and the potential seed of evil which ultimately forces itself out. The economy with which the picture of Macbeth's mind and the forces at work that influence it to adopt the course of treasonous murder is presented in the opening scenes of the First Act is a remarkable evidence of Shakespeare's skill. The whole action moves rapidly. Of course, Shakespeare's methodology does not take much care for, or make much count of, factual correctness and mere authenticity of events ; it is on the other hand a naive attempt to bring about the desired concatenation of events as rapidly and consequentially as possible. Nothing

is allowed to thwart the consummation of such a purpose. The First Act and part of Act II of Macbeth show Macbeth in action on the field of battle ; on his way to Duncan's Court, his encounter with the witches and the disastrous effect of that meeting on his mind ; the court of Duncan, his admiration of Macbeth and decision to accept his hospitability as a demontration of his gratitude ; Lady Macbeth's reaction to the receipt of her husband's letter containing the news of realised and prospective glory of Macbeth ; and amongst other items, the terrible consequence of her interference with Macbeth's own feeble will to let things go their own way, even though his desire to be the king is unconscionably inordinate. How Shakespeare packs all this with-in very limited confines is a testimony to his skill in plot construction.

Macbeth's plot is remarkable for its rapidity of movement. It is not due to any freak of genius, but is the result of calculated craftsmanship. The plot bears a close conformity to the motive of the play, which is to depict the fall of an ambitiously vicious man who otherwise might have been good. The study is not directed to how the 'crown' was won by Macbeth, but how the winning of the crown sealed his doom and led to his unchecked fall. The crown was from the very beginning within his grasp. Not only was Duncan no match at any time to Macbeth, but his murder was facilitated by the King's moving into the castle of the Thane of Glamis, The decision of the king to honour Macbeth by a personal visit to his Castle as his guest, prepares the reader for the eventual murder ; though Shakespeare makes him see the feeble internal struggle in the bosom of Macbeth on account of his desire *to be the king* and *his fear of consequences*. Since his fear is not rooted in any strong moral soil, it is shaken away by the more powerful resoluteness of the wife. The murder is accomplished as soon as the desire is formed in the mind of Macbeth. The story begins at this stage. The murder of Duncan takes place in the beginning of the second act, in the bosom of the exposition itself. The clue to Shakespeare's plot construction is the motive of the

play's design. Since the play aims at presenting the fall of an ambitious man without any moral scruple, its purpose could never be accomplished otherwise than by *putting Macbeth early in the story where he desires to be,* that is, *on the throne occupied till then by Duncan.*

It is only when Macbeth has exchanged places with Duncan, that his tragedy begins, and *curiously* enough, hence forward he is no longer wavering and oscillating as before. It seems as if the deed of murder had brought about a metamorphosis in his nature. It appears surprising that the man who was so unnerved by the first deed of murder should present himself so unwaveringly committed to a career of meaningless slaughter as he subsequently proves to be by his deeds ; but this is the crux of the problem. Macbeth is not changed. He remains what he was ; and the dramatist's design is nothing but to show this nature of Macbeth.

He was a man of courage and a great soldier, well occupied in the service of the king, full of promise and with amplitude of personal ambition, but totally lacking in strength that arises out of moral rectitude. He has good intentions and a sense of duty, but their roots are not embedded deep in the soil of moral uprightness. All his fear is about his own personal 'safety' if and when he committed murder ; and the deed does not upset him at all except in so far as its consequence involves his own security. That is hardly the right stand for any body to take, and certainly not such as can go unpunished.

The plot of Macbeth is constructed on the pivotal design of Duncan's murder. It is because of this that Duncan's murder takes place early in the story. Hence forward, the career of Macbeth is one of further crimes and horrors. The purpose of the story is to reveal Macbeth in his true colours—to show how he was a victim of his own nature. In the story of Macbeth, fortune also helps him in many ways both before and after the murder. Had Macbeth been a strong man in his loyalty to moral values, no undesirable effect could have been produced on his

mind either by his encounter with the witches or by the exhortations of his wife. But being weak in this respect, he succumbs to temptations offered by them. The result only proves disastrous for him. And to make matters more smooth and therefore worse for him, things immediately at the time of murder happen in a way to help him to secure his ambition without a hitch. The flight of Duncan's sons is only one such incident that helps a man to his own doom by making his moral fall easier by absence of any kind of obstacle. The murder of Duncan committed, Macbeth's task is to keep the crown to himself, and if possible, to pass it on, to his own heirs. Fortune has helped him in getting the crown, and he has to encounter no opposition at all as Duncan's sons have fled away. To make his position secure and safe is the task to which Macbeth directs his mind, and one of his earliest steps for the consolidation of his position is the plot against Banquo. He gets him killed as he fears him, not only as a wicked man is afraid of a good one, but as a guilty man is afraid of another one who knows or suspects his guilt. Macbeth's subsequent acts are motivated by a desire to keep himself secure on the throne ; but fear working on his mind which is devoid of any moral scruple only turns him into a monster. The scenic arrangement is based on this factor. Macbeth's actions have proceeded from only one assumption-namely, he can do his guilt with impunity. In the beginning, prior to murder, his whole self seeks no assurance but this whether he could commit a murder without being brought to book for it. Left to himself perhaps he might not have embarked on the course of crime. But guided by wife and encouraged by the witches, he is led into a belief that he could do the murder without suffering its consequence. That committed, he comes into his natural self and acts accordingly. The only assurance that he even now needs is a sense of security. This he cannot get from his wife. Lady Macbeth, therefore, sinks into gradual nonentity. She fades away into death. But the witches are still there and he seeks one more interview with them and receives from them *the assurance that he needs.* This fatal sense of security which he has been seeking to fortify

himself in his mad career of wickedness, is only the instrument of *Fate* to punish Macbeth more thoroughly by making him reckless and defiant. The plot is constructed to make the story of Macbeth's ruin—from ambition to murder, from murder to a sense of absolute personal safety, and from that feeling to a course of reckless murder and cruelty, which alienate all from him and reduce him to unprotected loneliness, and finally to death and ruin. Shakespeare's tragic plots are simpler in texture than the case is in comedies where multiple stories are woven together. In tragedies, not as a rule but generally, the pattern is of a single hero. The story spins round the fate of a single man whose ruinous fall is brought about by some fatal deficiency in his character. The story is so arranged that the 'hero' is exhibited in full lime light of personality. It is not the events of his life, but his character—that matter. Nothing could give us a true sense of plot construction by Shakespeare than a study of Hamlet's story. The study of his character is an interesting pursuit of critical scholarship. But the more simple and correct way of looking into his character is not to account for his delay in murdering his uncle, or anything relating to his procrastinating tendency, but to ask ourselves the simple question—how is it that Shakespeare has made this simple story go the full length of three hours' play by making Hamlet push off the deed of murder or vengeance each time he has had a chance for it. Not why he delays but how he delays—that's the crux of the matter and in that lies the skill of the plot-maker. The commission of a task to which Hamlet was pledged could only be delayed or obstructed by external obstacles, or by some kind of ineptitude on the part of the hero. Had Shakespeare made Hamlet commit the murder of Claudius, as Macbeth did in the case of Duncan, there might have been either no tragedy, since there is nothing to presume that Claudius's murder would have brought about any kind of nemesis against Hamlet, or it might have been but a feeble tragedy of Hamlet on perhaps the same line as Macbeth's, only a little different from the latter. But Shakespear had no such intention. He had set himself

to the task of providing a play for three hours to his audience who, perhaps, were familiar with its story. The task was as delicate as it was difficult, but the master's hand was equal to the occasion. The story is spun out slowly, revealing the motive of the revenge and the nature of the subject, who, though determined to do the right thing as he conceives, yet does not do so owing to natural hesitancy of his character which is a complex of a thinker and a man of action. The skill with which Shakespeare does this is remarkable in all details.

Hamlet is a drama of revenge. The story turns round the murder of a king by his own brother, which his son seeks to revenge. Every necessary detail in the story of *Hamlet* as would throw light on the task that he was called upon to undertake and the condition of mind in which he undertook it, has to be given to the reader to enable him to follow the course of events to be satisfied with the result as it heppened. The motive of the play is revenge, but in achieving his aim Hamlet himself had to pay full price with his own life. Whether he could not encompass the murder of his uncle and thereby satisfy his sense of duty in some other way than he did, is not the question. That he could not is a fact of dramatic art. Shakespeare was more concerned with the display of a character, not at variance with himself, but bafflingly introvert, who readily excuses himself out of action in order to prolong the duration of his task. The task of the dramatist was to lengthen the course of revenge to the full display of a Five Act Play, and he has so woven his plot that the story becomes an absorbing study of a hesitant personality, or indecisive character. The plot is slow moving in keeping with the hero's own nature, Throughout the first act, scene by scene, the purpose and the pattern of the play are revealed. Hamlet is the central figure, and his isolated situation and the profound loneliness of his condition are impressed on the reader's mind. He is living in an unsympathetic world, where he finds he can hardly take any body into his confidence. Not that there are external and outward difficulties in his way, or his enemies are too many or powerful, but it is the effect on his mind of the condition

in which he is living that matters. At the time when his father's ghost calls upon him to be 'avenged', he is in a state of bewildered isolation, not only because his own mother has alienated herself from him by indecently marrying Claudius so quickly, but also because of Ophetia's weak submission to act indifferently towards him in accordance with the advice tendered by her father and brother. At a time of so much grief and sorrow as it must have been to him owing to his father's murder, it was hardly possible for him to keep himself in a state of cool headedness and normallcy when all whom he saw round him were so much different from what he had expected them to be. No wonder that his own outward behaviour had changed so much. That he appeared as so much transformed is made clear by Claudius's words!

> "Something have you heard
> Of Hamlet's transformation so I call it,
> Since nor the exterior nor the inward man
> Resembles that it was."

Hamlet is not the gay young man that he had been before his father's murder: the sudden and treacherous murder of his father has brought about a change in him. The fact is that he is no longer his old self. He has passed through what might be termed a spiritual crisis—the new experience of what the 'world' is in which truth and honesty are discarded for their opposites, and men behave worse than devils. The Hamlet then, as the story opens, is a changed Hamlet confronted with the task of avenging his father's death. The plot is accordingly so arranged as to impress this clearly on the reader's mind. It is significant that the king should pointedly refer to this repeatedly in the beginning of Act II and III.

As the play stands, Act I gives us the preliminary details about the motives of the play. It only informs us of how Hamlet has been affected by his father's death, his mother's strange conduct and sudden change in Ophetlia's behaviour. Each one is vital to the understanding of Hamlet's mind.

That Hamlet takes a long time to carry out his design is obvious; He himself complains:

"I do not know why yet I live to say, *This thing's to do*". But it is of the essence of the plot that this act of revenge should be delayed to the end. The means adopted for this consummation are perfectly simple and natural. In the first place, Hamlet is a little above the average in every respect-including urbanity of character. He is a cut above the gallant youth of his age in the polish of his soul. How fine is his own character, can be perceived through a comparison of Hamlet with Laertes. And the plot helps us to make this comparative study, for the latter is placed exactly in the same situation as Hamlet, by the death of Polonius. What a contrast does Laertes present to the calm unmoving conduct of Hamlet so to say by the impetuosity of his open violence with which he reacts to the news of his father's murder. Laertes is the average ardent Dane of his age, fiery and revengeful in anger. Hamlet is different. He has a far finer conscience than we can imagine anybody to have. He would kill the murderer of his father but only after a good deal of heart searching. The knowledge of what has happened has produced such a shock on his nature that he becomes bewildered for a time. His strange conduct is almost bordering on lunacy, and in fact, is so construed by Polonius and others. To the former Hamlet is nothing but off his chump. Owing to disappointment in love, Hamlet too lends colour to this prevailing belief by the abruptness of his general behaviour and an apparent irrelevancy of his talks. Under the garb of insanity he has been seeking a means and a justification for the step that he wants to take. Claudius, who has perceived this unusual conduct of Hamlet and fears him on his own account, has been counter following, and when, he clearly perceived through the game of Hamlet, plots to have him despatched to England. The plot thus moves in a sort of a seasaw of manoueve ring between Hamlet and his murderous uncle, till things happen to bring the matter to a head. The story of Hamlet moves from point to point :

Hamlet confronted with the task of revenging his father's death :

Act—I

Hamlet stunned with his misfortunes and the sudden awakening of soul to the sordid reality of world which almost maddens him. The arrival of a party of actors is not only an opportune dramatic device for Hamlet but is a reminder of his jovial real self as he was before this change. Hamlet puts the play test to find the guilt of his uncle, and succeeds in laying the guilty man by the heels! Hamlet also gets a chance to open his mind to his mother and by killing Polonius gives a new direction to the play!

Act—II & III

But before Hamlet can take any further step, he has been despatched to England, and Polonius's death brings Laertes to the Capital, creating a new situation for Claudius, but providing a via media for the solution of the entangled knot of events. Claudius is able to pacify Laertes and by a master stroke of diplomacy arranges a sword fight between Laertes and Hamlet, in which he openly plots to have him killed, first by a poisoned sword and failing that, by a poisoned drink.

Act—IV

And finally comes the last act. Instead of reaching England, Hamlet has come back to his own country, thanks to a timely piratical attack on his ship. Ophelia's grief at her father's death only ends in suicide. The graveyard scene has provided a venue for the meeting of the two combatants. The last event of fight is easily arranged and as the result turns out, each is wounded by the other by means of a sword: the tip of which had been dubbed with poison.

Claudius's treacherous intention of poisoning Hamlet only recoils on his own head. Gertrude drinks from the venomed, chalice and drops down dead. Laertes confesses his guilt but not before he has accused the King whom Hamlet stabs dead. So ends this tragedy of a noble prince, whose life came to nothing inspite of many virtues that he possessed, because the world

to which he belongs, is not so composed that the correct thing always happens in it.

The motive of the play has thus a determining hold on the layout of the plot. The dramatist, like a skilful weaver, has to weave a texture of which the design is well known to him. Shakespeare works his plot in a manner that the links are never broken or disjointed. But it is not only this. The effectiveness of the dramatic story takes its root from the naturalness or logical necessity of events, and in this Shakespeare never misses to show his innate sense of propriety. Of course, there are occasions where things are forced for reasons other than strictly dramatic. But such occasions are rare, or their necessity can be understood and explained otherwise. In a multiple story plot, the interweaving of different threads in an overall pattern can be profitably studied by analysing any of his comedies, where the story is generally complex. *The Merchant of Venice* is a simple story of love in its basic form, but becomes a complex story on account of its different elements. It is not only a story of Bassanio and Portia, it is also the story of Antonio and Shylock ; and it is many other things. Even if one were to confine his attention to these two aspects of the story—viz. Bassanio-Portia and Antonio-Shylock, one can readily perceive the organic and constructive skill of Shakespeare in arranging the plot of The *Merchant of Venice.* Each could have been the theme of a separate play, and according to the prevailing tone, turn out into a comedy and tragedy. As it is, the two are combined together and give to the play of Shakespeare a peculiar flavour—which is neither-pure tragedy nor pure comedy. This apart, the construction of the play is a model of economic use of material to achieve multiple purpose. Shakespeare has maintained a balance of interest amongst all his principal characters by providing inter-links between his several stories. Antonio becomes at once the important instrument of Bassanio's good fortune by providing him with necessary money as well as the principal figure of tragedy in the trial scene. Portia is the central figure of interest on account of her position and is

also the instrument of destiny for Antonio. Shylock by loaning out money to Bassanio helps him prosecute his addresses to Portia successfully, and also converts himself into a champion of persecuted Judaism against Christianity. The design is complex, but the arrangement is very simple. And when the knot is unravelled, the simplicity of the problem apears to be almost flat. Shakespeare has also introduced other episodes and they are used with equal skill. The episode of Jessica-Lorenzo is woven to set off the character of Shylock and make him ridiculous in the eye of the Christian, it is also there in its own right-as a complex piece of Romantic Comedy. The exchange of rings which could be an independent motive in a play by itself only serves to maintain a connecting link between the different episodes and casts on them the appearance and colour of homogeneity. The successful use of diverse materials in comedies in the layout of their plots, is truly remarkable and forms a factor of their unfailing charm.

(II)

Shakespearean plots are not modelled on the principles of classical unities. No observance in regard to the unity of time or place is maintained in his plays. Even the unity of action is of a type which follows its own law, and is not in conformity with the classical practice. The action in Shakespearean plays has an organic harmony of its own and does not proceed from singleness of theme wherein there is no mixture of stories, or combination of variety. Shakespeare constructs his plays on a freer model than the classical playwrights were wont to do. In this respect he stands nearer to the Indian drama than to the Greek. Yet the pattern and design of his plays are as different from the one as from the other.

The dramatic form imposes certain conditions on itself because of its very peculiarity. The story, being laid out in scenic representation, is primarily a matter of visual projection and the spectator, before whom the play is representated, is an important though passive party in business. Much of the

need of the older unities arises out of this factor of the scenic representation at a fixed place, because the fixture of a venue denied to the playwright the liberty to move his events from place to place or from time to time, that might make too big a demand on the spectator's credulity. A certain practical consideration had to be preserved. Since the action going on before the spectator was taking place somewhere and at some time, it was considered hardly possible that it could shift away to anywhere or any time at will. The principle was one of elementary commonsense, yet there is no reason why the imagination of the spectator, who is already prepared to accept on demand a good many things should prove unequal to the task of accepting infringement of space and time unities in an action, where otherwise there is nothing to mar its plausibility. The reader or the spectator of the play has to activise his imagination a little more than is the case in any other literary form, and a dramatic story does not suffer on account of any gaps in time or space involved in action on any principle of artistic requirement whether the simpler pattern of classical craftsmanship is more impressive and covincing than the complex and freer romantic model, is a question of very little academic worth. Each has its own attraction and charm: but while the simpler classical form, by its very nature makes for the symmetry of execution, no such thing can be said of the complex Romantic type where owing to overcrowding or variety of incidents, greater attention has to be bestowed on architectonics of structure to preserve the dramatic unity of the story. This is secured only by harmonising the diverse elements into a fitting sequence of events with the help of a well-knit plot.

Shakespeare has infringed the canon of classical time scale of twenty-four hours for a play with such obvious disregard that it is amazing how he never is called into question even for once by the reader, who hardly seems to realise that what is happening before him could hardly, have taken place within the specified time limit. The dramatist does not only shift his incidents from time to time separating them by gaps, but within these

gaps also he does not maintain any consistency or arithmetical accuracy. There is a double timing in his plays. The principle on which his plays are constructed is lack of any principle based on any strict regard to time. He brings certain occurrences forming part of action together to present a continuous and consistent narrative and binds them with a time chain of its own, which is not based on actual timing but only on *artistic necessity of the plot.* The story has thus a twofold spacing in time—one actual according to the timings of occurences, and the other *dramatic*, according to how Shakespeare links them in the plot. The latter is more important. It is the organic layout of time in Shakesperean plot-the actual interval of time within which the drama has materialised from the initial to the last step of its course. The events in a play move on according to their timings as laid down by the necessity of the plot irrespective of their actual happening. Each scene has its own time of occurrence followed by other, and the spacing in time between scene and scene is indicated in the course of the *drama*, either directly or indirectly through stage direction or communication. This is the dramatic duration and the essential time log of the play. And yet, the separate events of which the story is composed had their own specific timings, and the story does preserve that where and whenever necessary. This double time scale is no necessary adjunct to the dramatic beauty of the plot, but only an evidence of Shakespere's free lance dramatic art-that could turn a seeming irregularity into a profitable device.

Shakespeare had never any squeanish regard for inventive originality. He borrowed his materials with the gusto of an extravagant borrower. Where his greatness lay was in the manner he utilised his material. Critics of Shakespeare have undertaken the task of comparing the original with the utilized form of his borrowings, and it has all been done with an exhaustiveness that cannot be improved. The significant thing about him is the skill and effectiveness with which he transformed the original stuff into wonderful dramatic stories.

That he did so through clever manipulation of plot device is the secret of his art. The more complex a story, the surer becomes the touch and unfailing in its effect the device of the artist. His plays are essentially dramatic, that is, action is never allowed by him to stagnate. The story is set moving from the very start, and as it goes on unrolling itself, it gathers its own momentum on account of the opposition of forces, that in the beginning develop separately and then come to a clash, resulting in the finale that settles the issue. The story is always something occurring, even though its outward medium in the form of dramatic dialogue may of itself be absorbing and brilliant. It is never the case that *words* stop the flow of action in Shakespeare. Each scene moves forward, is an advance on action, whether it helps it forward or holds it in check. The whole structure of the play is based on the law of movement. Beginning with the exposition, where the main threads of the story are held forth before our gaze, the development of the plot is concerned with creating the forces involved in the story, that seek solution. The principal in gredient in the evolution of the plot is the human element that supplies the lubricant to the wheels of the plot machinery. Shakespeare makes man work out his own destiny, and whether be suffers or enjoys, much of what befalls him is *due to himself*. The practice of the dramatist in relation to his creatures of imagination is based on the law of individual responsibility in a world where the mystery of chance has also its full play. The plot device of Shakespeare then, is based on the law of uninterrupted action flowing from individual acts and conforming to the principle of responsibility of the man for his deeds. He thus takes up the theme of an individual's life, and pieces together such significant details as set forth a clear picture of his life episode in a connected sequence of plausible events. Since his plays are sometimes based on more than one story, the different materials are so devised together that each helps the other in furthering the common story. A fantastic story like *A Mid-summer Night's Dream*, where imagination holds in abeyance the control of reason, is no exception to this rule. There are

as many as five distinct pieces forming the mosaic of this play. Not only do we have the story of Oberon and Titania's quarrel, or that of the Duke's wedding with Hippolyta : we have also the double story of two sets of lovers, each crossing the path of the other, and finally the funny and simple story of the Athenian mechanics. Shakespeare blends them all in a manner that binds them together in the complex design of the play, and yet at the same time retaining for each its individual life and form. The main story that of the human pairs is made to move under the impact of supernatural quarrel which ultimately also solves their entanglement as it is also linked with the two other elements of the Duke—Hippolyta nuptials and the Bottom fooleries, by obvious ties. The one moves into the other so naturally that the happenings never appear as not following the natural law of causal necessity. Oberon's displeasure with his fairy queen most naturally inclines him to teach her a lesson in which he makes use of Bottom in a most reckless manner : and the transformation of the weaver is the central key to the solution of the unhappy lovers' misfortune, who have been forced by their mutual love to brave the wrath of Equeus. The efficiency of the lovejuice may be pure blarney, but it is the only sesame for the consummation of Lysander-Hermia love. The Fairy God intervenes into human affairs, and the occasion is furnished most naturally by his own domestic misfortune. Thus the linking of these incidents follows the law of dramatic necessity in plot construction, and it is this that gives to the story its wonderful harmony. The Duke of Athens is on the eve of marriage, when the disputes between a father and a lover are reported to him. Though his own sympathies as a lover are with the young amorous ; he as the head of a state, cannot but follow thelaw, which compels the daughter to toe her father's line in marriage on pain of death. That being so, the painful nature of the law is explained to the obstinate lovers who decide most reasonably to kick the dust off their feet of such an irrational land by fleeing outside its boundaries. Young lovers are only innocent fools, and before they fly, they have passed on their secret purely for dramatic

necessity to make some more entanglement for them in their flight. Thus, not one but two pairs of lovers have wended their way to the forest. The Duke's wedding provides certain common people of Athens with an opportunity for display of their loyalty to the Duke by staging a performance before him on the marriage day. They are thus assembled in the same forest for rehearsal. Thus for one reason or other are assembled at one place all the characters in the play. The scenes are so connected that the incidents move in a natural sequence. Never is action delayed or stopped: it goes moving through all the entanglements of the play. It is only an instance of that mobility of Shakespearean plays, which is their marked trait. The art of the story teller is never put to a greater test of compression and effectiveness than in a drama: but its spirit remains the same. The best play is the one that lends itself to the most effective histrionic representation. Nothing that interferes with the true movement of the story can be of any help to the actor, whose role is most effectively displayed in action. The plays of Shakespeare are, from this point of view, more susceptible of emotional interpretation, because the story all along is a mobile piece of happening. *The Twelfth Night* is a passionate story of love in which too many cross currents commingle to form the whirling eddy of romantic life.

Orsino's love for Olivia becomes an excuse for the appointment of Viola as lover's ambassodor on behalf of the Duke to the grief-stricken lady who has abjured all male company on account of her father's death: and one thing leads to the other, so that the entanglement that arises out of happenings ultimately finds only a natural solution in weddings. It is the story again of judicious use of material to fit the dramatic purpose of a romantic plot. Viola's ship-wreck, her taking service in the count's household and employment as his messenger of love to Olivia, her charm and Olivia's falling in love with her at first sight, all are so well designed and pieced together that the results are never doubted or questioned, and while the complications arising are obviously perplexing, their easy disentanglement is not much left in suspense, because

the clue to solution is also simultaneously provided for in the remarkable physical resemblance of the two, Viola and Sebastian. While this part of the story is the main plank of the plot, its more interesting and truly Shakespearean side is the one contributed by Malvolio episode. It is a tribute to Shakespeare's genius that he welds diverse elements so perfectly and wondrously that the seeming incongruity and absurdity of the attempt only lends greater charm and attraction to the finished product. The greatest attraction of *Twelfth Night* for all time will remain Malvolio : and yet he is only a secondary picture in the drama, only a side show and not the main exhibit. The fact is that Shakespeare's stories are more concerned with what happens. As a matter of fact, their plots are happenings : and the dramatist links them invariably with perfect art, at least, with perfect skill, so that the result appears to follow naturally from its cause. There is thus a kind of a logical necessity in the action of the play, a working out of a law of life.

Prospero's trust in his brother and absolute neglect of his own duty as the king, having resulted in his exile, he gets one more opportunity of vindicating his knowledge and punishing his treacherous brother and his accomplies, when chance brings all these men in a ship near to the island of his banished existence. The story of the *Tempest* is the story of how Prospero wrought his vengeance on his enemies. But it was the vengeance of an enlightened man, of a man who all his life had been, more of a thinker absorbed in the pursuit of knowledge than anything else. Whatever way one may look at the story of the *Tempest*, the incidents of the story are so arranged as to make the picture of Miranda's falling in love with Ferdinand its absorbing glory which puts to shame every base element of our sinning humanity. The love of Miranda is of a class by itself, entirely different from anything in any other play. For once, things can happen as planned : and the end has been laid down long before the beginning is made. For Prospero nothing is impossible, and he was for once to play his part well and to purpose. The dramatist is much like Prospero in his design and method. It will not do for him to leave things to

chance, as the latter has the knack of ousting master and take control of the kingdom of art. The artist can ill afford doing it, and if he neglects his simple duty, nothing but exile falls to his lot. He must awaken to a sense of reality and loyalty to his work, and having done so must order each little piece of happening to fall in the manner and for the purpose he wishes. That is the only way in dramatic art. Plot is a matter of skilful planning, and in a good play every incident is thoughtfully linked with the rest. Art is only life modelled on a plan. Whatever purpose behind the plan according to the vision or the urge of the artist might be the design and method underlying it are his first concern which he must ordain with meticulous care and true vision. This is the secret of plot making. Each detail has to be worked out and interlinked with the other to constitute an unwinding story of moving action. The master plan for all his plays is alike, though his tragedies are more concentrated on account of their nature and form than comedies or histories. But in all the paramountcy of art is unquestioned. The scenes are so adjusted as to constitute one continuity of story, arising out of forces at work. Shakespearean plot is thus an unfoldment of incidents in a manner which is conditioned by its own story. Chance and character intervene to give not only a direction to the story but also to justify the consequence, thereby emphasising the uncertainty and mystery of life where reason does not always prevail. *Deus et Machina* is a helpful device to resolve in a desired manner any entanglement in a dramatic story : and its help has often been taken. But it is not always very satisfactory to make use of this device. In Shakespeare, such a use is rarely made, but a timely coincidence is not precluded. At times, endings are made to take a conventional shape owing to prevailing taste of the age. Beyond these minor adjustments, the plot in a Shakespearean play is only a logical arrangement of incidents which are so set together as to produce a convincing account of happenings. Events follow events in a sequence of effective causality.

स्वर्गीय भारत-रत्न डा० भगवान दास के दार्शनिक सिद्धान्त

डा० भीखनलाल आत्रेय

डा० भगवान दास (१८६९–१९५८) वर्तमान युग के भारत के महान् दार्शनिकों में एक थे। उनकी महत्ता इस बात में है कि उन्होंने दर्शन की जीती-जागती आधुनिक समस्याओं का प्राचीन भारतीय दर्शन के सिद्धान्तों द्वारा, जिन्हें वे शाश्वत् तथा सार्वभौम मानते हैं, समाधान करने का सफल प्रयत्न किया है।

आधुनिक युग के उत्पन्न वे एक प्राचीन ऋषि के समान लगते थे जो सभी समस्याओं को अपने दृष्टिकोण से देखता हुआ इस बात का पूर्ण सन्तोष रखता था कि वह इन समस्याओं का समाधान बिना कठिनाई के सरलता और पूर्ण सन्तोष के साथ कर सकेगा। उनके मतानुसार सत्य सभी युगों और समयों में एक सा रहने वाला है और यह सत्य सनातन वैदिक धर्म के सिद्धान्तों में प्रतिष्ठित है (जो वैदिक धर्म नित्य ज्ञान के रूप में प्रतिपादित है) वही सिद्धान्त विभिन्न देश और काल में उत्पन्न तत्त्वदर्शियों द्वारा खोजा तथा सिखलाया गया है। विभिन्न काल तथा विभिन्न देश के धर्मोपदेशकों की शिक्षाओं में तात्विक भेद नहीं है। वे भाषा और विषय विशेष पर जोर देने के कारण ही एक दूसरे से भिन्न हैं, इस सिद्धान्त का प्रतिपादन उन्होंने अपने महत्वपूर्ण ग्रन्थ सभी धर्मों की तात्विक एकता में किया है। (Essential Unity of all Religions)

उनका महान दार्शनिक ग्रन्थ "शान्ति विज्ञान" (Science of Peace) है जिसका पुनर्जन्म नवीन प्रकाशन "आत्म विज्ञान" (Science of Self) के रूप में हुआ है, प्रधानतः इनमें यही सिद्धान्त प्रतिपादित है जिसका अन्वेषण उनके असन्तुष्ट तथा जिज्ञासु मन ने उनकी अट्ठारह साल की अवस्था में कर लिया था। बहुत वर्षों के पश्चात् उनको यह जानकर महान आश्चर्य हुआ कि जिस तथ्य पर वे अपने स्वतन्त्र विचार के आधार पर पहुंचे थे उस तथ्य का प्रतिपादन बहुत समय पूर्व एक प्राचीन लेखक गागांयन ने अपने "प्रणववाद" में किया था और उस ग्रन्थ का अन्वेषण, अनुवाद तथा प्रकाशन डा० भगवानदास ने स्वयं भी किया। उनका सम्पूर्ण दर्शन संस्कृत के तीन शब्द "अहम्" "एतत्" "न" में यह हूँ नहीं के द्वारा व्यक्त किया जा सकता है जिसकी सांकेतिक अभिव्यक्ति उनके विचारानुसार संस्कृत शब्द ओम् में है जो भारत के प्राचीन ऋषियों द्वारा बहुत महत्व का माना गया है। तथा जिसका निर्देश कठोपनिषद् के प्रसिद्ध संदर्भ में मिलता है।

सर्वे वेदा यत् पदमामनन्ति तपांसि सर्वाणि च यद्वदन्ति।
यदिच्छन्तो ब्रह्मचर्यं चरन्ति तत्ते पदं संग्रहेण ब्रवीम्योमित्येतत्॥ कठ० १।२।१५

अर्थात् समस्त वेद नाना प्रकार और नाना छन्दों से जिसका प्रतिपादन करते हैं सम्पूर्ण तप आदि साधनों का जो एक मात्र परम और चरम लक्ष्य है तथा जिसको प्राप्त करने की इच्छा से साधक निष्ठापूर्वक ब्रह्मचर्य का अनुष्ठान करते हैं, उस परम तत्व को मैं संक्षेप में बताता हूँ वह है ओम्।

डा० भगवान दास के मतानुसार परमतत्व की अभिव्यक्ति नित्य चैतन्य के रूप में "मैं यह हूँ नहीं" इस प्रक्रिया के द्वारा सम्यक् प्रकार से हो सकती है। आर्य शास्त्र में उसे ब्रह्म कहा जाता है जिसका संकेत ओम् है। यह वह अनुभव या चैतन्य है जिसमें द्वैतानुभव के दोनों छोर ज्ञाता तथा ज्ञेय, मैं और यह, विषयी तथा विषय, अहंकार तथा अनहंकार, जीव और अजीव, चेतन और जड़, आत्मा और अनात्मा, ईश्वर और जगत, पुरुष तथा प्रकृति, परमात्मा तथा माया, चैतन्य तथा अचैतन्य सदा सम्मिलित, निमज्जित तथा निषिद्ध हो जाते हैं। वे वहां रहते हैं और वे वहां नहीं भी रहते हैं।

जब हम लोग अपने को चरम अनुभव तक उठा लेते हैं, तब द्वैत का निषेध हो जाता है या हम द्वैत के ऊपर उठ जाते हैं और ऐसा प्रतीत होने लगता है कि वह द्वैत न वहां किसी समय था और न वहां रह ही सकता है। इसे परा दृष्टि कहते हैं। यह चरम दृष्टि-कोण हैं जिसे प्राचीन भारतीय दर्शन की माया में 'अजातवाद' कहते हैं। सत्य का ज्ञान निर्विकल्पक स्वानुभूति द्वारा ही प्राप्त हो सकता है यह बुद्धि विलास के द्वारा गृहीत नहीं हो सकता है। इसके ग्रहण के लिये हमें अपने द्वैतानुभाव से उपर उठना हीं पड़ता है।

चरम अनुभव (मैं यह हूं नहीं) के भीतर द्वैत का एक छोर 'मैं' सदा विद्यमान रहता है। न तो वह इससे बाहर जाता है और न अपना तादात्म्य ही खोता है यद्यपि वह चरम-अनुभव तक पहुंच पाता है। यह 'मैं' ईश्वर चेतन्य है जो विषय समष्टि के जिसे हम असत् या जगत् के विषयों की जननो कहते हैं, सदा विरुद्ध है। यहां वह चैतन्य कुछ विषयात्मक सा बन जाता है फिर भी वह विषय समष्टि से जो असत् है, भिन्न ही रहता है। यह चैतन्य विषय समष्टि से भिन्न रह कर भी उसका स्वामी तथा नियन्ता बना रहता है और स्वयं किसी भी भांति उनके नियन्त्रण में नहीं आता है। केवल वह इनकी सत्ता का तब तक निराकरण नहीं कर सकता जब तक वह अपनी सत्ता का निराकरण नहीं कर लेता। दोनों (मैं और यह) साथ ही आते हैं और साथ ही जाते हैं। एक के बिना दूसरे की सत्ता टिक नहीं सकती। दोनों अपने तादात्म्य को पूर्णानुभव में समाप्त कर देते हैं। वास्तव में ब्रह्म अपने को उस प्रकृति से सीमित करके ही ईश्वर बनता है, जो उसके समक्ष रहती है और जिसके साथ वह तादात्म्य का आधान करता है तथा जिससे विरक्त होने की निरन्तर इच्छा करता रहता है। यह (प्रकृति) शरीर है जिसका आत्मा ईश्वर (चैतन्य या 'मैं') है।

दूसरे शब्दों में ईश्वर समष्टि या अहंकार है (यहां समष्टि का तात्पर्य विषय समष्टि से है किसी विशेष सृष्टि से नहीं जिसका कोई विशेष ईश्वर होता है) यहां अहंकार का अर्थ स्ववश सक्रिय जगन्नियन्ता चैतन्य है। ईश्वर के जीवन में, चाहे वह कितना भी बड़ा क्यों न हो, तीन क्षण होते हैं। प्रथम सृष्टि-जिसमें विषय में रुचि, ध्यान, आसक्ति तथा तादात्म्य का आधान होता है, जो विषय को सत्यता तथा स्थिरता प्रदान करती है। दूसरी स्थिति-जो विषयों के साथ अनन्त प्रकार से क्रीड़ा करना है। तीसरा प्रलय-जो विषयों से विरक्त तथा उनसे अपने को पृथक् करना तथा उनके निषेध के द्वारा अपनी चरम शान्ति में अपने स्वात्म्य को भी खो बैठता है। मैं और यह अनुभव के दो विरुद्ध छोर हैं, अतः

उनकी स्वभाव में एक शाश्वत विरोध है। 'मैं' एक है यद्यपि विषय दृष्ट्या प्रत्येक व्यक्ति से सभी सम्भावित प्रकार से भिन्न है फिर भी प्रत्येक व्यक्ति अपने को 'मैं' कहता है जब कभी भी वह अपना निर्देश करता है। सभी व्यक्तियों का सर्वसाधारण तथा प्रथम उत्तर है कि 'मैं' हूं। यह विषयी रूप छोर है जो समी विवेकशील प्राणियों में एक रूप से विद्यमान है। विषय की ओर अनन्त बहुत्व है।

अत: विषय समष्टि ईश्वर की अवच्छेदक उपाधि है जो अनन्त बहुत्व का उत्पादन करता है। ईश्वर ही समय में इस विषय समष्टि को स्वीकार या निषिद्ध कर सकता है और जब वह ईश्वर इनमें आसक्त होता है या इनके साथ तादात्म्य की क्रीड़ा करता है, या प्रत्येक अंश या अंश समूह से अपनी आसक्ति का निराकरण करता है, तब जीव रूप से वह क्रमशः इस विषय को स्वीकार या निषिद्ध कर सकता है। अनन्त विषयांशों या पहलुओं में प्रत्येक की सिद्धि या असिद्धि के द्वारा जो 'मैं' (चैतन्य) का अवच्छेद है, वही विश्वात्मा को जीवात्मा बनाने का कारण है। फलतः अनन्त एवं असंख्य जीवात्माओं की उत्पत्ति और उनकी जीवन यात्रायें हैं।

प्रत्येक व्यक्ति में दो पहलू होते हैं एक 'मैं' हूँ (सर्व साधारण विषयी का छोर) और दूसरा 'यह' का अर्थ विषय समष्टि का अंश है। एक विषय के साथ तादात्म्य का आरोप स्वभावतः अन्य विषय के साथ तादात्म्य का निषेध करता है। प्रत्येक विधि के पीछे निषेध, आशक्ति राग के पीछे वैराग्य लगा हुआ है। जब तक विषयी 'मैं' समस्त विषय से एक ही साथ अपने तादात्म्य का निराकरण नहीं कर लेता जो पहले समस्त विषय के साथ तादात्म्य का आधान किए बिना असम्भव है, तब तक यदि वह एक विषय के साथ तादात्म्य का निषेध या एक विषय का निराकरण करता है तो उसके साथ ही साथ वह अन्य विषय को स्वीकार करता है तथा उसके साथ तादात्म्य का आधान भी करता है। यह प्रक्रिया अनन्त तक चलती ही रहती है जब कि 'मैं' (चैतन्य) समस्त विषय से असन्तुष्ट होकर उनके मिथ्यात्व और असत्व का साक्षात् अनुभव नहीं कर लेता।

विषय के असंख्य भागों का क्रमिक स्वीकरण तथा निराकरण "काल" के अनुभव का जन्म देता है तथा एक साथ कुछ भागों का स्वीकरण या निराकरण दिक् के अनुभव को उत्पन्न करता है। एक विशेष "एतत्" (विषय) से दूसरे की ओर "मैं" (चैतन्य) की क्रिया गति कहलाती है, तथा दूसरी अनेक "एततों" विषयों का एक साथ ग्रहण करने का अनुभव नवीन एतत् (विषय) के साथ तादात्म्य के स्वीकरण की प्रवृत्ति इच्छा कहलाती है। विषय के साथ स्व का तादात्म्य स्वीकरण आशक्ति तथा उसका निराकरण अनाशक्ति है।

किसी विषय की ओर "मैं" (चैतन्य) की वृत्ति ज्ञान है तथा चेतना-वृत्ति का अभाव अज्ञान है। चैतन्य का विषय के साथ जो तादात्म्य है वह विषय को स्वचेतन अभिमानी तथा व्यक्ति विशेष बना देता है तथा चैतन्य को विषय विशेष बना देता है। इस प्रकार विषय की असंख्य संख्याओं में से प्रत्येक संख्या क्रमशः प्रवृत्त होकर शाश्वत्

परिवर्त्तन तथा विकास को उत्पन्न करती है और एक साथ ही छोटे से छोटे अणु से लेकर बड़े से बड़े ब्रह्माण्ड तक, असंख्य वस्तुओं को पैदा करती है।

चरम अनुभवों में "मैं यह हूँ" और "मैं यह नहीं हूँ" इन दोनों प्रवृत्तियों का पूर्ण संतुलन या एकीकरण हो जाता है, अतः मैं की चेतना नहीं रह जाती। यह तादात्म्य, निषेध, व्यक्तित्व परिवर्तन, नानात्व आदि, बन्धन, दुःख, कष्ट, पाप आदि केवल उन्हीं के लिए रहते हैं जिनकी प्रवृत्ति सीमित है तथा जिनका सम्बन्ध केवल अंश के साथ ही है तथा जो झट एक अंश को छोड़ दूसरे अंश के अन्वेषण के लिये आतुर हो उठते हैं और तब ये अपने को किसी दूसरे अंश के साथ सम्बन्धित करते हैं और प्रथम अंश के साथ अपने सम्बन्ध का विच्छेद करते हैं। यह प्रक्रिया तब तक चलती रहेगी जब तक वे विषय समष्टि मात्र का निषेध नहीं कर लेते या जब तक वे विषय-विषयी भाव के ऊपर उस चरम अनुभव तक जो नित्य—आनन्द स्वरूप है, नहीं पहुँच जाते।

संक्षेप में यह डा० भगवान दास का समन्वयात्मक ब्रह्मवाद है, जैसा कि मैंने समझा है। इस दर्शन के ऊपर उनका आचारशास्त्र, समाजशास्त्र, राजनीति, मनोविज्ञान, तथा साधना-मार्ग, आदि सभी आधारित हैं जिनका बिशद विवरण उनके अनेक प्रकाशित बहुमूल्य ग्रन्थों में है, जिनका अध्ययन बड़ा ही रुचिकर है।

मैंने डा० भगवान दास के शान्ति-विज्ञान नामक ग्रन्थ को बहुत पहले पढ़ा था और और तभी से मैं उनके प्रशंसकों में हूँ। उस महान् ग्रन्थ के पढ़ने के बाद उनके मूलाधार तत्व से पूर्ण सन्तुष्ट न होकर मैं इस निष्कर्ष पर पहुँचा हूँ कि यह जीवन तथा जगत् को पूर्ण रूप से स्पष्ट नहीं करता अतः मैं किसी अन्य सिद्धान्त को खोजता रहा जो हमारे जीवन और जगत् को पूर्णरूपेण व्यक्त कर सके और अन्त में मैंने एक सिद्धान्त ढूँढ़ निकाला है।

मेरे विचार के अनुसार अनुभव के तथ्यों की अभिव्यक्ति इस सिद्धान्त द्वारा पूर्णरूपेण हो सकती है कि "मैं वह बनूंगा जो मैं नहीं हूं"। हम अपनी वर्तमान अवस्था से कभी भी सन्तुष्ट नहीं रहते हैं और ईश्वर भी शायद अपनी पूर्णता से कभी भी सन्तुष्ट नहीं रहता। उपनिषदें कहती हैं कि वह निःसीम और निरपेक्ष अद्वैत ब्रह्म सीमित, सापेक्ष और अनेक (जीव) निःसीम निरपेक्ष और एक बनने की इच्छा करता है। सभी ओर हम इस प्रकार के असन्तोष का साम्राज्य पाते हैं। प्रत्येक वही होना चाहता है जो वह नहीं है। वद्ध मुक्त होना चाहता है और मुक्त वद्ध बनना चाहता है क्योंकि प्रत्येक अनुभवकर्ता को अपनी स्थिति सन्तोषजनक नहीं है। गतिहीन गति चाहता है और गतिमान् गति की निवृत्ति। बिना किसी अपवाद के यह नियम जीवन के सभी क्षेत्रों में सामान्य रूप से दीख पड़ता है। हम शेली के शब्दों में कह सकते हैं कि—

हम आगे और पीछे देखते हैं
और उसके लिए लालसा करते हैं जो हमें प्राप्त नहीं है।

GEOLOGY IN INDIA

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I. Introduction
II. *Early Period.* (Ancient times to 1200 A.D.)
  (*a*) *Vedic Age*
  (*b*) *Post-Vedic Age*
  (*c*) *Historical Age.*
III. *Medieval Period* (1200-1800 A.D.)
IV. *Modern* Period (1800-Upto Present time).

I. Introduction

It has been the almost universal custom until quite recent times to deny the existence of any science before the modern period. This is no longer possible. It is true that science can be derived by a continuous tradition from the Védic age, though the bridge connecting them with the modern period has been partially broken down through the loss of the historical tradition. That there was a connection and influence of the Védic researches on the various branches of science and on the modern researches is certain.

The present paper discloses a few important facts to show how India was immeasurably in advance of the times and had anticipated the Western scientific scholars in the intellectual development of science they had made even at that distant date, not to say in the remote period of time, when all the other ancient nations including even the Egyptians, the Babilonians and the Assyrians were still in the dark.*

In his history of India Thronton says "Ere yet the pyramids looked down upon the valley of the Nile—when Greece and Italy those cradles of modern civilization housed the tenants of the wilderness—India was the seat of wealth and grandeur".

* Geological Researches of the East and the West compared. Shri N. B. Pavgee.

It is surprising to note that the word "*Vijnānam*" meaning science is frequently used in Védic literatures. In sanskrit "*Vijnānam*" is used for the things which are directly observed i.e., *Pratyaksham* or *Aparoksham*. In Bhagwadgīta the term "*Vijnānam*" is used to explain the physical knowledge which is of two types *Aparā Prakriti* (physical knowledge) and *Parā Prakriti* (intellectual knowledge). In Taittriya Upanishad there are two words *jnānam* and *vijnānam* defined as *Parōksham* and *Aparōksham* or *Pratyaksham* respectively.

Man is a tool-using animal—nowhere do we find him without tools. Thus Palaeolithic man between 100,000 and 7000 B.C., according to S. H. Ball used 13 different varieties of nonmetallic stones—Chalcedony, Quartz, Rock Crystal, Serpentine, Obsidian, Pyrite, Jasper, Jadeite, Amethyst. He also utilised Ochres or mineral paints. At about the time Neolithic, man became acquainted with gold and copper. These materials are mostly common substances that probably were found by accident and whose quest neither greatly stimulated human curiosity nor created specialised knowledge regarding their occurrence. They were accepted as found and utilised. Geology had not yet arisen ; it was the pre-dawn stage.*

II. Early Period

(*a*) *Védic Age* :—

Our knowledge of Indo-Āryans is based on the evidence of Védic literature of which the chief constituents are four collections known as the *Rig Veda*, *Sām-Veda*, *Yajurveda* and *Atharva Véda*. The *Samhitās*, *Brāhmanās*, *Aranyakās* and *Upanishads* represent four successive stages in the development of Védic literature. This sacred stream of literature deals with philosophy, religion including ethics-ritual and ceremonial, cosmogony, cosmology, geography, astronomy and the allied sciences.

Mention is made in the *Rig Véda* itself of three metals *Hiranya* (gold) *Rajata* (silver) and *Ayas* (iron). Of *Hiranya* there are about more than hundred references in the *Rig véda*

* Brief history of the use of minerals : A. Bateman, p. 6.

which gives a clue that the ancients had a good knowledge of this metal. Varuna as "wearing a golden coat of mail". Chariot of Marut (one of the twelve Adithyās) as "golden weeled and iron spiked" (R. V. I. 88-5) are well known examples which show that gold was very well known in that age. About *Rajata* (silver) there are few references which may be due to the fact that this metal was little used in that age.* As regards the metal *Ayas* (iron) there are many references in *Rig véda.* Iron castles are spoken of in the *Rig véda.*

Prati yad asya vajram bāhvor dhur hatvi dasyum
Purāh āyasīr nitarit!

"When they placed the thunderbolt in his (Indrās) hand he slew the Dasyus and overthrew their iron castles".

Now coming to *Yajurvéda* we find the mention of other metals like *shīsham* (lead) *Trapu* (tin) along with *Hiranyam* (gold) *Ayas* (iron) and *shyamam* (copper)

Hiranyam cha mé Ayas cha mé shyāmam cha mé Loham chamé Sīsam cha mé Trapu cha mé Yajnena kalpantām
(Mā. Samhita 18-13)

The sacrificers (*Yajamānās* who perform the *yajnā*) ask these metals as boon.

The common Sanskrit word *Tārma* is used in *Yajurvéda* itself as

Asow yas Tāmrah Tāmra varnah and *Tāmrāya chārunāyachā* (M. Samhita 16-6 & 39)

in order to describe the colour (*varna*) of Sun at the time of dawn and dusk. In *Sāmvéda* there are many references of gold as "Soma juice entering in the golden jars" Sun and its light as light as gold etc.

Besides the knowledge of metals in early Védic period, our védic *rishis* were also acquainted with the knowledge of fossils is clear from the following verse of *Rig Véda.*

Twé vishwā Saraswati shritāyūmshi Dévyām
(R.V. II. 41. 17)

* Metallurgy in Ancient India—G. S. Upadhyaya, B.H.U. Journal, Pt. III, 1959, p. 240.

"O Saraswati all life is in thee, who art divine". This above poetic expression appears to be an original idea in the researches of geology as the poet had apparently hit upon some geological discovery, that vitality had first come into play in the region of the river Saraswati.

R. T. H. Griffith translates the above verse as "In thee Saraswati, divine all generations have their stay".

While discussing the region of the Origin of life, Shri N. B. Pavgee with the help of above verse of *Rig Véda* proves the knowledge of fossils to the Hindūs of the hoary past, for he says "Védic Researches in Geology (R. V. II. 41-16) conveys the idea that the river Saraswati was supposed from the geological point of view to be the scene of vitality and the region where life had first commenced after the earth cooled down, as the verse says that all life or generations are in the river Sarswati". For it seems from the investigations in geology, continued during védic period, that Rishis had probably came across some fossils (remains of ancient animals preserved in the rocks) in the beds and the regions of the river, and as these were considered to be the earliest life types it was naturally thought that life had its origin in that region. The modern investigation in this branch of science also supports the vedic supposition. As Mr. Medlicott says "and the most ancient form of life occurs (in India) near the Eastern end of the hills" viz. Salt range of the Punjab (Manual of Indian geology P. XXIV). Noetling has recently described a series of strata as underlying beds containing the remains of genus called Olenellus in North Western India ; and he confirms the conclusion of Waagen that this series of strata contain fossils.

Geological speculation had also made some headway among the Ionians. A hundred years before Herodotus,* Xenophanes of Colophon, a philosophical poet, had noted that shells are found far inland, and that in the quarries of Syracuse were imprints as the Greeks called them, or as we say, fossils of fish seaweed or so forth and from these observations he had drawn

***Great historian Herodotus born about 485 B.C. in Halicarnassus.**

the conclusion that what was then dry land must once have been under water.

Mention is made in *Rig véda* about the first appearance of Herbs and weeds as

Yāoshadhīh Pūrvā jātā dévébhyāstriyugam Purā
*(R.V.X.97-1.)

Some three epochs before advent of man these herbs and weeds appeared. This is also mentioned in *Taittiriya Upanishad*. *Prithivyā Oshadhayah* (T.U. II. 1.) : Herbs that appeared on Earth (after it has cooled down).

From the later periods of *Samhitās*, *Brāhmanās*, *Aranyakās* and *Upanishads* (sub-divison of védas), we get a perfect knowledge about the theory of Earth's origin from primary gaseous state to final solid form, which our védic fore-fathers have proposed, and compares very favourably even with the accepted modern geological ideas.

From the substance of what has been stated in the *Taitiriya Samhitā* it appears to have been supposed that at first all was liquid, which was probably surrounded by gaseous matter, later on this subsequently transformed into the Earth.

Apō vai idamarné Salilamāsīta Tasmin Prajapatirvāyu bhūtva............acharati............Sa prithivyābhavat/
(T.S. 7. 1. 5. 1.)

The ideas of *Taitiriya Brāhmanās* go a step further and declare that the Earth was at first a burning globe of gaseous matter (Nebula).

Tasmāttapanāddūmō ajayata/............Agnirajayata/

The researches of *Taittiriya Upanishad* is remarkable as it represents to us a vivid sketch of the Earths origin in its true colours-though the language used therein seems to us at this distant date enigmatical and the sense abstruse.

Tasmādvā etasmāt Ākāshah sambhūtah/Ākāshādvāyuha/ Vāyoragnih/Agnerāpah/Adbhyah Prithvi/Prithivyā

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*Griffith Translates it as "Herbs that sprang up in time of old, three ages (that is three epochs) earlier that the Gods, (Gods are but men endowed with superior qualities) N. B. Pavgee.

Ōshadhayah/oshadhībhyonnam/Annāt purushah/(Tai. up. 2. 1) This description may, in brief be said to be the geological evolution of cosmos from the infinite space (*Ākāshah*) which having given rise to Atmosphere (*Ākāshadvāyuh*) and this produced fire *Vāyōragnih*). The fire produced water in course of time (*Agnérāpah*), thus giving rise to a thermal ocean. The waters of the thermal ocean were highly crystalline and hence the formation of primary (igneous) rocks or the primitive crust. Similar description we also get in *Taittiriya Brāhmanās.*

**Tām (Prithivī) Sharkarābhih Adrumhat* (Tai. Br. I. 1.3)

Gradually the primitive crust having been partially broken up (continental drift ?) land and mountains began to rise above the waters (*Adbhya : Prithivī*). Then herbs appeared (*Prithivyā oshadhayah*) and then after three epochs† man evolved from simple organism (*oshadhībhyōnnam. Annātpurushah*).

An attempt is made in *Prithivī Sūktam* to classify the rocks comprising the crust of the earth.

shilā Bhūmirashmā. Pāmsuhsā Bhūmih Sandhrutā dhruta/
Tasyai Hiranyavakshasé Prithivya Akaram Namah/26.

The crust is mainly composed of hard rocks (probably granite) Agrillaceous (clay) Arenaceous (sandy and Pebbly) rocks.

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* The text from *Taittiriya Brāmhanā.*

"Brihaspati or the planet Jupiter was first recovered when confronting or nearly occultihg the star Tishya". On this observation Mr. Ketkar has endeavoured to establish, that this sort of observation of the heavenly bodies was possible only at about 4650 B. C. and thus the T. Brahaman was composed nerrby 4650 B. C.

† In short according to the Rig-Vedic geologists, after our planet cooled down and acquired a suitable condition for existence of life herbs (*oshadhīh*(, appeared in the first geological period (*Pūrvā Jātā*), viz. Palaeogoic era ; while in the third or the Tertiary era, the Mammalian cless with the man as crowning peace of creation made its appearance *Devebhyastriyugam Pnrā* (R. V. X. 97. 1.)

A description of the Pleistocene glaciation, the latest event in the geology we get in *Aitaréya Brāhmanā* (7-15).

Kali shayanō Bhavati
samjihānastu Dwaparah/
uttishtamstrétā Bhavati.
Kritam sampadhyaté charam
(A. Br. 7-15)

Manu also refers to this as

Kalih prasupto bhavati sa jāgradwāparam yugam/karma-swabhyudhyatéstrètā vicharamstu kritam yugam
(Manusmriti 9. 302)

Our vedic fathers have been designated the Ice age as the deluge (*Pralayah, Aughah*) for the oldest of these accounts has been incorporated in the *Shatapatha Brahmana*. Lokmanya Bal Gangadhar Tilak: the author of the Orien and the Arctic Home in the vedas says "The story of the Delugė is found in such an ancient book as the *Satapatha Brahmana*, the date of which has now been ascertained to be not later than 2500 B. C. Nevertheless, it seems that the Indian story of deluge refers to the same Catestrophe as is described in the Avesta, and not to any local deluge of water or rain. For, though the *Shatapatha Brahmana* mentions only a flood (*aughah*), the word *pralaya* which Panini (VII-3-2) derives from pralaya (a deluge), signifies snow frost or ice in the later sanskrit literature. This indicates that the connection of the Ice with the deluge was not originally unknown to the Indians, though in later times it seems to have been entirely overlooked". (Arctic Home in the vedas (Page 387)

As regards to the antiquity of this Ice age Mr. N. B. Pavgee says "our Vedic fore-fathers having seen the great Ice Age they were good enough to kindly give to their progeny and to the world the true picture and lively account of what they themselves had seen, heard or known by tradition". Our vedic geologists however had divided this glacial epoch of enormous length into three yugas; viz. *Krita*; *Treta* and *Dwāpara* while *Kali* was according to their notion the beginning of quaternary age". (Episode of the Glacial period. N. B. Pavjee)

(b) *Post Védic Age*

Comming to the post Vedic Age which embraces the ages of the Mahābhārata, the Rāmāyana and those of the Smiritīs and Purānās, we find a tremendous development in the ideas of the people about the subject of minerals, usage of metals, about cosmogony and evolution.

Mahābhārata (*Sabhāparva*) speaks of a Mountain where gems and precious stones occur. There are frequent allusions in the same literature, made to the successive vital gradations which distinctly show knowledge of, and aquaintance with, the various geological periods ranging from Vindhyan (*vindhya kāl*) of the Palaeozoic vitality to the Miocene period (*shivālik yuga*) of the Tertiary'* times. In Ramayana (*skandotpatti*) gold is described by the name of (*Jālārūpaṃ*). The dreadful (*Loha-Mukha*) Iron-faced man is described in Ramayana. Rāvanā's capital Lanka used to be called "*Swarna Lanka Puri*"

Coming to the times of Manu @ again we find a description about the stages by which our planet is formed.

> *Āsīdidam Tamōbhūtam Aprajnātam Alakshanam/Apratarkyam Avijnéyam Prasuptasmiva Sarvatah/Apa ēva sasarjādow Tāsu bījam Avasrujat/*
> (Manusmriti I-5/8)

He says all this was at first in a chaotic state. The heavens then created waters and our planet became enveloped therein. Subsequently life appeared on it and gave rise to a variety of Progressive vitality. "*Byabahāra*" (Secular law) compiled by sage Jāgnabalka, deals with the deterioration of metals when treated with fire (*Byabahara sloka 181*). In "*Achārā*" (conduct) Jāgnabalka speaks about the purification of lead, copper, impure silver and gold. (*Achara sloka 190-91*). *Basistha Sámhita*' (Chapter III and V) Makes refeence to copper bell-metal silver, gold gemstones and pearls.†

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* Vedic discoveries in Geology, N. B. Pavgee, p. 11.

As to the Age of Manu it appears that he flourished some 3000 years ago or 1000 years B.C.

† S. K. Roy, J.B.O.R.S., p. 273, 1941.

The sequence of origin of certain major groups of animals as explained in Indian Mythology viz. *Agnipurāna* and *Vishnu Purāna* seems to indicate that the early Hindūs had some concept of evolution.*

Akarōtsa tanūm anyām kalpādishu yathā purā/
Matsya Kūrmādikam tadvadvārāham vapurāsthitah/
(V. Purana I. 47)

The sequence known to them-first that of the palaeozoic fish (*Matsyāvatār*) the second that of the Mesozoic, Tortoise, representing reptiles (*Kurmāvatār*) the third of the boar (*varāhāvatār*) followed by the cainozoic Man-lion† representing mammal (*Narasimhāvatār*) and Dwarf-man (*Vāmanāvālār*) broadly coincides with modern evolutionary theories.

Reference to the above incarnation theory of evolution is also made in Shatapatha Brāhmanās. "As to its being called *Kūrma* (a tortoise), *Prajapati* having taken this form, created offspring".‡

In 'Taittiriya Brahmana'as :—

Sa (*Prajāpatih*) *Varāho rōpam Kritvo panya-manjat/*
(T. Br. I. 1.3.6)

"He (*Prajapati*) having assumed the form of a boar plunged beneaths" (into waters) §

However the above description though brief, is yet concise and graphic, and brings vividly to our mind the chain of events that had occurred in evolution from primitive fish to a man. Thus it gives a proper view of the vedic studies in geology.

In 'Vishnu Purana' the rock in which gold occurs is mentioned as :—

shubhrāmanayo yatra suprabhāh Anena Suvarna ratnāsthitirlabhyaté/ 2, 5, 6.

"Gold is commonly associated with white stones"

* Palaenotology, Palaobotany and prehistory in India, Dr. M. R.Sahni, J.P.S.I., Vol. I, p. 9.

† For Man-lion the western geologists substitute chimpanzee or the age.

‡ The amphibians proper not being mentioned.

§ Muits original S. T. Vol. I page 54, Second ed.
Muirs original S. T. Vol. I page 53, Second ed.

This point is very interesting from the geological point of view as the present geological investigation of gold also shows that it is associated with quartz-vein which is a white stone (*shūbhra-manyo*) as said above.

The auriferous sand deposits are described in 'Vishnu Purāna as well as 'Matsya Purāna' showing the knowledge of placer gold to our ancient Hindūs. 'Vishnupurāna' Mentions about *Jambunād* (a variety of gold) which occurs along the coast (V. P. 2/4/21). 'Matsya Purana' (113, 72) describes a place where the whole land is made up of small sands of gold.

Sarvāmanimaye bhomih Sukshma-Kānchana-bālukāh
(M. Purana. 133. 72)

The gold washing industry still in existence in some of the areas from the rivers viz-Swarnarékha and in Bilaspur confirms the above idea of gold placer in India. The process for obtaining gold was very simple and consisted of gathering the auriferous sands (*sūkshma-Kānchana-bāluka*) from the river beds and washing it by mechanical means.

As regards the iron there are innumerable references but some of the western scholars are still in doubt about the usage of iron in such a remote past because the iron comes at a later period in cultural history, and they wonder whether Indians could have been familiar with iron at such an early age of wrold history. There are reference in the literature of this period about the metallurgy of iron showing India's achievement in the field of Metallurgy'.*

The Age of the Earth as calculated in 'Surya Siddhanta' about 2000 million years broadly coinsides with the latest calculation by radio-active methods for finding out the age of the Earth. In Bhuvanā Kosha an idea about the wandering of the poles and shifting of equater is described.

Lankā ku madhye yamakotirasyah............................
..................................*vadavānalascha* //17//
(Bhuvan kōsh-Golādhyāya)

* Metallurgy in India, G. S. Upadhyaya, B.H.U. Journal, Pt. III, 1959, p. 241.

The wandering of poles is also described by western geologists recently to explain the phenomena of glaciation and Palaeoclimates.

Mention is made of gems and jewels in the earliest writings of the Hindūs. According to S. H. Ball the use of gemstones and the mining of them reached a high art among the early Egyptians, Babylonians, Assyrians and Indians. The Vedās speak of a place illuminated by rubies, diamonds, which gave out light as refulgent as that of the planets. *Sūryakānta* (Sun stone) *Hīrakam* (diamond) *Muktikam* (Pearls) *Chandrakānta* (Moon stone) are also mentioned. The 'Garuda Purana' quotes 'Vyadi' as an authority on gems. The same literature under the heading of 'Ratna-Pariksha' (examination of gems) devotes several chapters to a detailed description of gems. The crystalline character of the minerals is referred to in one or two places. Mention is made up of diamonds as having six angles, eight faces and twelve edges.

kōtyah Pārshvāni dhārascha Shadashtow dwādashēti.
(Garuda Purana)

This octahedral form of the crystal is common in the diamond occurring in the neighbourhood of Panna in Bundelkhand.

The 'Kama Sutra' of 'Vatsyayana' describes the testing of gold and gems, knowledge of the colouring of gems as also of mines and quarries. In the Post-Vedic ages of *Samhitās*, *Aranyakās*, *Srauta Sūtras* where sub-division of the Āryan life according to occupation are given we find the mention of Lapidris, Jewellers, Smelters and Smiths ; Bronze, iron, copper, gold, lead and tin are some of the metals (consequetly their minerals) known to Indian of this age.

All these Vedic and Post-Vedic literatures only mention that metals and precious stones occur among big mountains, but where these big mountains were no mention has been made. But the recent geological investigations in this field made it clear that the ancient Hindus were probably referring to the

Aravallis (where there is a treasure of Precious stones and other metals), the Himalayas, Panna, Kolar and Dharwar areas.

From the priceless treasure of Vedic and post-Vedic literatures it is clear that the Hindus had a good knowledge regarding the various branches of the Earth Science (viz: Cosmology, Geology etc.) although the language used there in seems to us, at this distant date, enigmatical; yet it gives to the world lively account and the true picture which our Vedic forefathers and their hoary ancestors had established.

Besides these above literary documents a number of ruined mines and old workings existing even now in many areas viz: Singhbhoom, Khetri, Singhana, Almora, Andhra Pradesh Malabar (Kerala) etc., and the unearthed implements discovered during the excavation at a number of places which date back to even 3000 to 4000 B.C. enable us to have a look for ourself how the ancient Hindus of the past were in a state of perfection regarding the knowledge of Mineralogy, Mining and Metallurgy.

As regards the history of Mica-Mining in Kodarma area, there are records to support that Lavanas were first to work Mica in this area. Names of old Mica-Mining like Surangi, Ladirangi, Lomchanch, Domchanch, Karaktambi are in the language of the present day Mushaharas, the successors of the Lavanas. Similarly Iron smelting Smiths of the Mandi State and the Kamirs of Nepal are the hereditary Smiths and the Smelters of the Country.*

The excavations of ruined Mohanjo-daro afford us a glimpse of a Civilization which was indeed of a very high order at least from the Materialistic point of view. Gold used in Indus-valley appears to have come from the mines at Kolar and Anantapur district.† Copper may have come from Rajputana. The use of Bronze during this remote period indicates a great advance over contemporary civilizations in metal working. Lead was extensively mined during this period and

*S. K. Roy, O.B.R.S., p. 267.

†The Indus-Valley Civilization—A. D. Pusalkar, Vedic age page 184-185.

Zawar (Udaipur) may have supplied lead to the Indus-valley.*

Among the Ornamental stones Amethyst, Amazon, Agate, Blood-stone, Jadeite, Jasper and Plasma were in plentiful use during Indus-Valley civilization. Besides this Mohanja-daro Archaeological evidence other records such as excavations at Nevasa in the Ahmednagar Dt., Maharashtra (between 1500 and 1000 B.C.), near Gilund in Udaipur district, Rajasthan (1500 B.C.) and a settlement of Chalcolithic times found at Navdatoli in the Nimar district, Madhya Pradesh (1700 and 1100 B.C. radiocarbon test) also supports the fact that ancient Hindūs had a good knowledge of minerals, metals and in the art of mining and Metallurgy.

(*c*) *Historical Age* :—

The earliest available historical data reveals that during the historical age (600 B.C. to 1200 A.D.) there was a great advancement in the knowledge of minerals and mineraloindustry in India. The *Arthashastra*† of Kautilya (Chanakya about 4th century B.C.) offers ample proof and sufficient evidence in this subject. The whole of Chapter XII of the second book deals with various rules and regulations regarding mining operations, mine management and manufacture of metals from minerals. This Chapter brings out most marvellous facts about the knowledge of Geology, mining and Metallurgy prevalent in India in the 4th century B.C. Kautilya even speaks of the manufacture of artificial gold from other metals.‡ He mentions

*If it is asserted then we can expect similar civilization to that of Indus-Valley in all these areas viz. : Kolar, Anantapur of S. India, Rajputana, Ajmer etc., and there was a communication between these areas. Thus it gives an idea that the Indus-Valley Civilization not only was restricted along the Indus but it has spread as far as South (Kolar) in search of noble metals, or it may be migration of men from the north (along the Indus-Valley '*Sapta-Sindhavah*' cradle of the seven rivers) due to the refrigeration of climate during the Pleistocene priod. Although the later interpretation is not supported by the geologists. —Authors.

†Translated by Dr. Shama Shastri.

‡Dr. Winternitz, Vishwa Bharati quarterly, Kartic 1330 B.S. (p. 263).

the use of lead in a scientific process (cupellation) applied even in the modern times. This process was named* '*Kharpar vidhī*'

A glimpse of the extent of development of the mining industry during the reign of Chandra Gupta can be had from the very fact that two officers, the Superintendent of mines (*Ākarādhyaksha*), the Mint Master (*Lohadhyaksha*) were appointed to manage the affairs of this industry. The qualifications of Superintendent of mines as described in Kautilyas Arthashastra are given as under "He must be posssed of the knowledge of science dealing with copper and other minerals ; experienced in the art of distillation and condensation of Mercury and testing of gems. He must be aided by experts in Mineralogy and equipped with mining labourers and necessary instruments. Thus it may be noted from the above that the *Ākaradhyaksha* (Superintendent) had to supervise the mineral deposits more or less in a manner similar to that of the present day Geologists of Geological Survey of India. "(S. K. Roy J. B. O. R. S. Volume XXVIII Part III)".

Quoting the Sociopolitical literature subsequent to Chanakya especially the 'Sukraniti' Dr. Bagchi says "It is well known in ancient India these were Government Officials to supervise the works of all kinds of labourers and artisans so that the inclusion of the term miner in the Sloka above does not necessarily show that these miners were labourers working in the royal mines-most likely there was a department of mines in ancient India whose officers supervised the labour of private mines. This supervision was all the more necessary because the King derived a large amount of revenue from mines in the shape of duties and under these circumstances the Sumantra had an important duty in informing the King the amount of taxation from minerals and metals". (Dr. Bagchi, Law of minerals in Ancient India).

In book II Chapter XII of Arthashastra Kautilya describes the process of identification of various ore minerals by means

*Metallurgy in Ancient India—G. S. Upadhyaya, B.H.U. Journal, Pt. III, 1959, p. 242.

of their physical properties such as form, colour, hardness (Present day mohs scale ?) and smell. He also tells us the purification processes of these minerals from their superficial impurities both by mechanical means (ore-dressing of the present day) and by Chemical processes (Metallurgy). In the end he speaks of the uses and places of occurrence of these ore minerals.

The fact that "Ratnākaram" the ancient treatise on gemstones is still held in such a high regard that it is considered to be the last word on gems, indicates the perfection of knowledge in the mineralogy of gemstones attained during these days. Most of the European names of semi-precious gemstones like quartz *Kartaja,* Garnet *Gōkarna mani* Tourmaline *Turnamala Mani* Corundum *kurundama Mani* etc., originate from their Samskrit names as found in Ratnākaram.* Not only the historic people were in acquaintance with the metals and gemstones, but they were knowing the properties and usage of refractory minerals also is clear from the fact that Emperor Ashoka presented a towel of asbestos† to the King of Ceylon through his son. Thus showing even the asbestos mines were worked by the ancients.

Megasthenes was a contemporary of Chanakya. Unfortunately the original work of Megasthenes on India is lost, but from the fragmentary statements quoted by some writers we find that in his times a large number of mines existed in India that were worked by miners. The following lines of the Greek writer Megasthenes are of considerable interest especially because it is for the first time we get a Geological description. "Underground (in India) there were numerous veins of all sorts of metals, for they contain much gold and silver and copper and iron in no small quantity and even tin and other metals which are employed in making articles of use and ornaments as well as the implements and accoutrements of war".‡

*Mineralogy and Mining in ancient India—S. K. Roy, J.B.O.R.S., 1941.

†Asbestos—S. K. Roy, Bill No. 5, I.R.S. Bihar, p. 1.

‡Ind. Ant., Vol. VI, p. 120.

Here the description of tin bears the greatest interest. The Greek name for tin, 'Kassiteros' is moreover said to be derived from the Samskrit *Kastira*. That India produced Tin in sufficient quantities for exploration is most improbable for we do not find at present the enormous ancient mines of tin as we do find for copper, gold etc. which was indigenous to India. The tin which she did export probably came to the Indian parts from the Malayan countries or Tenasserim.

The next source of evidence in the chain of literary works of historical importance is the *Lōh Shāstra* (science of iron) of Pātanjali the great commentator of the grammaria Pānini who is considered to belong to 2nd century B.C. Although the valuable and original work of Pātanjali on this science of iron is unfortunately lost to us, the importance of the work and its contents is clearly borne out by the portions quoted from it by later writers.

Now we enter the golden age of ancient India when the Guptas held the sway over whole of .the country roughly from the 4th century A.D. to 6th century A.D. It was during this period that the knowledge of mineralogy, mineral prospecting and mining attained a very high state of perfection. "It is in this period of Gupta rule that Tamralipti (Tamluk) was still a famous port through which large quantities of copper of Singhbhum used to be exported to foreign countries. Kohinoor was discovered in the diamond mines of Golkonda province and thus Golkonda province became a famous diamond mart". (S. K. Roy. J.B.O.R.S. Vol. XXVIII Part III p. 280.)

Damucus blades made up of cast steel or *wootz** were introduced to Arabia by India along with other metals and gemstones in large quantities.

It was in this period that copper mining was first started in Singhana Khetri areas (Rajasthan). The old copper slagheaps occupied the whole of Singhana town, Jhun-Jhunu

* The name Wootz according to Lassen, Ind. Alter (Vol. I, p. 239), is derived from the Sanskrit, from two words signifying diamond and thunderbolt, *Vajra*.

Dt. Other historical evidence show beyond doubt that hundreds of families mined and smelted copper here during this period. The ancients sank here more than 200 shafts, some of which are more than 100 feet deep viz : Madan Stope, Kudan stope ; and their locations discloses an accurate knowledge of the occurrence of the ores. How their knowledge of Geology especially in Ore-propsecting and mining was perfect, is clear from the examination of old-workings in Khetri, most of them now in ruinous and water-logged condition.

The greatest achievement of the Gupta age is the iron-pillar standing even now near the Kutub-Minar in Delhi. Fergusson speaks the following words of the iron-pillar of Delhi-. "It opens our eyes to an unsuspected state of affairs to find the Hindus at that age capable of forging a bar of iron longer than any that have been forged even in Europe upto a very late date and not frequently even now. It is almost startling to find that after an exposure to wind and rain for 14 centuries, it is unrusted and the capital inscriptions are as clear and as sharp now as when put up 14 centuries ago". (Dr. N. R. Dhar. Cultural Heritage of India Vol. III, P-415). The pillar is practically pure iron, its iron content being 99.720% (Sir R. Hadfield's analysis)

The huge iron girdles at Puri and the ornamental gates of Somnath and the 24 feet iron-gun at Narvar are other excellent samples of Hindu skill in Metallurgy.

Yet during the successive centuries and until the establishment of the Mohamedan rule in 1200 A.D. various Hindu Kings like Yashodharman (530 A.D.) Sasanka (600 A.D.) Harshavardhan (606-64 A.D.) Yashoverma (700 A.D.) Lalitaditya (730 A.D.) made attempts to build an empire in North India ;* but unfortunately the valuable treatises of this period are untraceable and unknown, except that of Vrihat-Samhita by Varahamihir (587 A.D.) This literature conveys much useful information on the knowledge of gems and precious stones.

* R. C. Majumdar, Cultural heritage, Vol. III, p. 64.

Varahamihir even mentions the causes of impurities in gemstones due to the inclusions of minute gravels.

Kalushā Manddhutayō Lekhā Kīrnāh saddhātavah Khandah/
Purvigdha Na Manòjnah Sasharkarāshcheti Mani doshah//

Here *Sadhātavah* and *sasharkarāh* no doubt refer to the minute inclusions enclosed in the body of the stones.

It is sometimes asserted that the phosphorescence of diamond was first observed in 1663 A.D. by Robert Boyle; but King Bhoja (11th century) however speaks of this property.

Andhakārécha dīpyaté
(Phosphorescence in the dark)

King Bhoja in the Chapter on *Shastrayukti* mentions a number of varieties of iron as well as their properties.

Thus the above records make it clear that the science of Geology especially mineralogy, ore-prospecting and mining was very much advanced during the historical period similar to that of modern period.

III. Medivael Perigd (1200-1800 A.D.).

This period which embraces 1200 A.D. to 1800 A.D. in history shows a decline in the knowledge of Science and Arts which is probably due to the invasion on India by the foreigners. It is during this period that great monks were either killed or they fled to other parts e.g. Nepal, S. India and Burma* and nearly all the holy literatures were destroyed. Yet we are fortunate enough that there are certain literatures of this period available. The Sanskrit literature of this period like *Rasa Ratnakar* (12th Century A.D.) *Rasendra Choodamani* (12-13 century A.D.) *Rasa Ratna Samucchaya* (13-14 century A.D.) *Rasa Kalpa, Rasa Raja Lakshmi* (14th century A.D.) *Dhatukriya* (16th century A.D.) describes the topics of extraction, purification of minerals and metals along with their properties nearly in the same manner as it is done at present.

* S. K. Roy, J.B.O.R.S., Vol. XXVIII, Part III, p. 283.

In the first chapter of *Rasa Ratna Samucchay's* Vagbhatacharya speaks of the origin, occurrence and extraction of Mercury from Cinnaber (*Girisindura*)

Shailesmin...............shata yojana nimnāste jātāh.
..............kupāstu Pancha cha//
(R.R.S. Chap. I.)

This old idea coincides with modern view about the origin and occurrence of Mercury. Besides this the properties of Calomel (*Hīrakadhyuti*) as mentioned in 'Rasakamadhenu' (P. 573) is exactly similar to one given by modern mineralogist. *Hirakadhyuti sankāsham* (*Lustre admantine*) *Pramānātvīrakāt kvachit kvachit* (Fracture Conchoidal). Much of the second chapter devotes to the properties and purification of Mica (*Abhraka*) gems (*vaikrānt*) Pyrites (*Mākshika*). The third chapter of the same literature deals with the origin, varieties of *Uparasas* such as Sulphur (*Gandhakam*) Haematite (*Gairikam*) Orpiment (*Haritāl*) Pyrrhotite (*Kānta Mākshika*) and Stibnite (*Sowviranjan*) etc. Vagbhata only mentions that "*Giri Sindura*" (Cinnabar) occurs Among the big mountains, but where these mountains are located is not described.

The other literature 'Rasa Ratnakara' deals mainly with the purification of important *rasas* (Minerals) such as extraction of the essence of *vaikranta* (probably a mineral of the spinel group) ; extraction of copper from *Makshika* and *Tapya* (varieties of Pyrites) and Zinc (*Jasada*) from calamine (*Rasaka*).

The foreign traders and historians who visited India during this period described marvellous facts about the knowledge of Diamond and Precious stones digging, prevalent in India during that time.

A notable authority on the mineral production of India during the Thirteenth century is the famous Venetian traveller, Marco Polo.* In reference to diamond he states that it was only obtained in what he designates as the kingdom of Mutefili-a name which has been identified by Colonel Yule with Motupalle

* Marco Polo Vol. II, p. 284 Note 6.

a still existing port in the Guntur Dist. of Andhra Pradesh. The proper name of the kingdom was Telingana which, therefore, included the so called Golkonda mines of the Krishna valley. Marco Polo in various parts of his book refers to other precious stones, copper, gold and silver.

Ferishta (1425) refers to a now long-deserted diamond mines in the Central Provinces of India. At the close of the fifteenth century Nicolo Conti gives an account of the locality where the diamonds were found. In the year 1503 Lewes Vertomannus : a German traveller who travelled through South and Western India describes the mining of diamond. Six miles away from the city of Deccan (? Bisnagar) is a mountain where diamonds are dug†

Ferishta gives also a full account of rubies, spinel, diamond, saphire, topaz, hyacinth and emerald and mentions the localities where they were obtained, but these details are too much for reproduction here.

Garcias Honto : a physician resident at Goa, in 1565, produced a work in Portuguese‡ which tells us that there are two or three localities near Bisnagar (Vijayanagar) where diamonds were obtained. He also tells about a mine in the Deccan which produced excellent diamonds. This last was probably identical with the mine at Wairagarh in the Central Provinces.

The famous traveller, Fitch and his companion Newberry, have left on record an account of their journeys in India.$ In reference to precious stones, the following passage is of utmost importance.

Bellergan, the modern Belgaum was said to be "a great market of diamonds, rubies, sapphires, and many other soft (i.e. Precious) stones".

† The History of Travel and C by R. Eden and R. Willes, Lond. 1577, p. 383.

‡ De Arom. et Simp. Historia, a latin version by Clusius of Sntwerp, 1567.

$ Hakluyt's English voyages, Vol. II, 1599, p. 253.

Abul Fazl-the author of Ain-i-Akbari written in 1590, refers to the occurrence and working of several mineral deposits especially diamonds, gold, iron and copper. The diamond mines at Beiragarh in Gondwana which he mentions may be identified with the modern Wairagarh in the Central Provinces, where traces of the mines are still to be seen.

Gold was obtained, he says, in certain streams in Kashmir by pegging down under water, the hairy skins of animals which served to arrest the auriferous dust in its descent with the current. The anormous salt deposits of the Punjab are also described by Abul Fazl. Here the following passage of Strabo may be quoted "It is said that in the Territory of Sopeithes there is a mountain composed of fossil salt sufficient for the whole of India. Valuable mines also both of gold and silver are situated, it is said not far off, among other mountains, according to the testimony of Gorgus : the miner of Alexandria*

In the accounts of his several journeys in India, Tevernier (1665-1669) has given us a considerable amount of information about the workings of gold, diamond, rubies and sapphires.

Captain Hamilton, who traded in the East Indies between the years 1688 and 1728 informs us that Iron was made into anchors at Balasore, apparently by European methods ; if it is accepted, this was the first manufacture of that kind in India of which there is any record. He quotes a curious story as to mercury having been brought to Sumatra from Andaman islands by a native, which he stated was obtainable there (in the little Andaman). This statement along with a consideration of Geological structure, indicates the possibility of a future discovery of mercury in the Andaman islands. There are several points of Geological resemblance between some of the rocks of Andaman and those of California which contain the valuable mercury mines.

All these above facts, placed within the reach of historians clarify the great antiquity of the knowledge possessed by the

* B. XV, Chap. i, S. 30.

natives of India ; with reference to the subject of Mineralogy, Mineral Prospecting and Mining-Geology.

The progress and civilization of our nation as Bose remarked, was greatly hampered by the end of twelfth century. Every work that has the stamp of originality had been written before the close of that century. Dhar attributes the intellectual stagnation in India after the close of the twelfth century among other causes, to the decline of Buddhism under whose aegis Science and particularly medicine had developed considerably in the Universities and Hospitals attached to the Buddhist Monasteries, to the revival of Brahmanism and the zeal shown by Neo-Brahmins in discarding and neglecting all those things that were cherished by Buddhists ; and finally to the unsettled state of affairs and lack of security in the country resulting from repeated foreign invasions and constant changes in Government. Other factors also probably operated to bring about such a degeneration of the mental powers of the people who had been responsible for great advances in the earlier centuries that almost upto the end of the 19th century no original scientific work of any importance was carried out by Indians.*

After the foundation of the Asiatic Society in 1784 results of the most important researches carried out in this country were published in Asiatic Researches (founded 1788).

IV. Modern Period 1800 upto present

With the dawn of the Modern Period a great land marked evolution took place in the intellectual development of the Science of Geology. The revival of the study of Sciences in India within the last two centuries as Sir Lewis Fermor† attributed, was due to the Scientific Societies, as Royal Asiatic Society (1784) Geological, Mining and Metallurgical Society of India (1924) Mining, Geological and Metallurgical Institute (1906),

* Prasad : Progress of Science in India, XIII, I.S.C., 1938.

† Year book of the Asiatic (Inaugural number) Society of Bengal, Volume I 1935, p. 9-23.

Palaeontological Society (1956) Indian Science Congress etc., Survey Departments (as Geological Survey of India (founded 1851), Indian Bureau of Mines, Oil and Natural Gas Commission, Atomic Energy Commission and the Scientific Officers in various Services and Survey departments. Since the foundation of the Geological Survey of India (1851) eminent geologists on its staff and others have contributed important monographs or shorter papers in that department's serial publications—The Memoirs (founded 1856) Palaeontologia* Indica (1861) and Records (1868). Within a few decades the Science of Geology began to make deep impressions on the learned world.

Now there is hardly any branch of Science which is not included in the Science of Geology. The subject of Geology can be grouped into three main divisions : one is Palaeontology and Stratigraphy, the other is Mineralogy, Petrology, Crystallography and Economic Geology and the third is Dynamical and Structural Geology. Recently with scientific development, a number of new branches have come into existence like Isotope Geology, Engineering Geology, Hydrology, Petroleum Geology, Nuclear Geology, etc., which may be also classified in one or the other of the above mentioned three major divisions. It will not be out of place to write a few lines here about the pioneer Indian workers in various fields of Geology. In fact all the progress which Geology has seen in Indian soil is due to the ceaseless and selfless efforts of these Geologists who have devoted their entire life for the sake of the Service of Science.

Palaeontology and Stratigraphy

Geology in general and Palaeontology and Stratigraphy in particular, owes a lot to the Late Prof. Birbal Sahni, the Late Prof. H. C. Dasgupta, Prof. L. Rama Rao, Dr. D. N. Wadia, Prof. Rajnath and Dr. M. R. Sahni. Prof. Birbal, Sahni the renowned Palaeobotanist and the founder of Institute of Palaeobotany at Lucknow contributed much to the field of Palaeo-

* Dr. M. R. Sahni : Journal of the Palaeontological Society of India, Vol. I, No. I, p. 11.

botany. The two memoirs dealing with coniferales are worth mentioning.

The late Prof. H. C. Das Gupta's contributions covered different branches of geology, mineralogy, petrology, palaeontology, Indian stratigraphy and also Indian prehistory.

As an eminent Palaeontologist the valuable contribution of Prof. L. Rama Rao on the highly controversial Cretaceous Eocene boundary is definitely an advancement in the Stratigraphical knowledge. The work of Dr. D. N. Wadia on Himalayas especially Kashmir Himalayas will remain a lime light. It will not be out of place if we say Dr. Wadia means Indian Geology and Indian Geology means Dr. Wadia. His book "Geology of India" will remain as a guide not only to the present but as well as to the coming generation of geologists.

The valuable contribution of Prof. Rajnath on the world famous Jurassic rocks and fossils will ever remain unchallenged in the field of Stratigraphy and Palaeontology. To his credit he has established a research nucleus in the Geology Department, B.H.U. where a band of enthusiastic and brilliant workers are engaged in the research work of high standard on Jurassic rocks and fossils of Kutch. Dr. M. R. Sahni formerly in the Geological Survey of India where he served in various capacities and is at present Professor of Geology, Chandigarh University, Punjab. Besides a number of contributions in Stratigraphy and Palaeontology he established the Palaeontological Society of India of which he is President.

Petrology and Economic Geology

The debt that present day geologists owes to Late Prof. K. K. Mathur is incalculable for his researches on Girnar and Pawagarh hills speak about his extraordinary talents. He was the founder of the Geology Department, Banaras Hindu University and the good name which this Department owes is due to his ceaseless devotion to Geology. Dr. M. S. Krishnan was the first Indian Director of Geological Survey of India, after India achieved independence. He has worked particularly

on all branches of geology especially in the field of economic geology. The worth mentioning is about the Gangpur series which shall remain as a milestone in the field of Economic geology.

Besides the other contributions the late Shri P. N. Bose has given India one of its great Iron-ore deposit which he discovered in 1904.

The late Prof. Sampat Iyengar, the late Prof. S. K. Roy, Dr. B. Rama Rao, the late Dr. P. K. Ghosh, Prof. N. N. Chatterjee, Prof. N. L. Sharma, Prof. D. K. Chakravarti, Dr. K. P. Rode, the late Shri A. M. N. Ghosh, Shri W. B. Metre, Dr. C. Mahadevan, Dr. A. G. Jhingran and Prof. S. R. Kilpadi are among the others responsible for the development of Geology in India.

Mention should be made of Sir T. H. Holland, T. H. D. La Touche, C. S. Middlemiss, Sir L. L. Fermor, J. A. Dunn, H. H. Hayden, J. B. Auden, R. D. Oldham, E. Vredenberg, O. Fiestmantel, H. C. Jones, Percival, A. M. Heron, E. H. Pascoe, L. F. Spath, G. E. Pilgrim and W. D. West, who since the 50's of the last century, have made Indian Geology what it is to-day.

Besides these above mentioned scholars there are many geologists in the field as well as in the educational institutions who are devoted to the pursuit of knowledge and increasing service to the cause of Geology and the promotion of research in India.*

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नीतिवाक्यामृत

[ले० श्री वासुदेव शरण अग्रवाल]

श्री सोमदेव सूरि अपने देश के बहुत ही विचारशील विद्वान् हुए हैं। वे राष्ट्रकूट नरेश कृष्णराज तृतीय (९३९-९६८) के समकालीन थे। उन्होंने नीतिवाक्यामृत नामक एक बहुत सुन्दर ग्रन्थ लिखा है, जिसमें ३२ समुद्देश या अध्याय हैं, जिनमें संक्षिप्त सूत्र शैली में राज्य-संबंधी नीति का निचोड़ दिया गया है। वस्तुतः मानव जीवन में बुद्धिमत्ता या समझदारी मनुष्य की सबसे बड़ी शक्ति है। इसी में जीवन के बहुमुखी अनुभवों का सार आ जाता है। भारतवर्ष में इस प्रकार की नीतिमत्ता को बहुत ही महत्त्व दिया गया था। प्राचीन काल में जीवन के प्रति इस प्रकार का दृष्टिकोण प्रज्ञा दर्शन कहलाता था। विदुरनीति उसी का उदाहरण है। और भी चाणक्य नीति आदि नीति के ग्रन्थ उसी परम्परा में हैं। पंचतंत्र नीति साहित्य का मुकुटमणि ग्रन्थ है। उसका प्रचार विश्व की अनेक भाषाओं में हुआ। अब तो वह विश्व-साहित्य का एक अनुपम ग्रन्थ माना जाता है।

यहां एक पते की बात बता देना आवश्यक है। प्राचीन संस्कृत शब्दावली में बुद्धिमत्ता के जिस गुण को प्रज्ञा कहते थे, उसी का पाली भाषा में रूप 'पञ्ञा' और प्राकृत में 'पण्णा' रूप हुआ। उसी परम्परा में एक दूसरी प्राकृत बोली में प्रज्ञा का ही रूप पण्डा हुआ, जिससे पंडित शब्द की व्युत्पत्ति हुई। भारतीय संस्कृति में पण्डित शब्द का एक विशिष्ट अर्थ और महत्त्व लोक में व्याप्त है। जो प्रज्ञावान् है, जो जीवन की व्यावहारिक बुद्धिमत्ता के प्रति सजग है, उसे ही पण्डित कहते हैं। भारतीय नीतिशास्त्र के विशाल साहित्य में जीवन सम्बन्धी बुद्धिमत्ता की अत्यन्त विस्तृत सामग्री पाई जाती है। एक प्रकार से देश भर के समष्टि गत पाण्डित्य की वह निधि है। हमारी शिक्षा-संस्थाओं में नवयुवकों के मन को शिक्षित करने के जो आयोजन चल रहे हैं, उनके पाठ्यक्रमों में नीति साहित्य को विशिष्ट स्थान देना उचित है। मानवीय बुद्धि के लिये यह एक ऐसा अमृत है जिसके पान से मन में नया उज्ज्वल प्रकाश भर जाता है। अनेक प्रकार के व्यवहार प्रत्येक व्यक्ति को करने पड़ते हैं। व्यवहारों के समुदाय का नाम ही सामाजिक जीवन है। प्रत्येक व्यवहार के विधि-निषेध या ऊंच-नीच के पक्ष को संतुलित रूप में साथ लेना ही नीति है। सोमदेव के नीतिशास्त्र में इसी प्रकार की शिक्षा का वर्णन है।

ग्रन्थ में ३२ समुद्देश या अध्याय हैं। पहला धर्म, दूसरा अर्थ और तीसरा काम समुद्देश है। सोमदेव का पहला सूत्र बहुत ही विशिष्ट और आधुनिक भाव वाला है—'उस राज्य को नमस्कार है जिससे धर्म, अर्थ और काम, ये तीन फल प्राप्त होते हैं।

अथ धर्मार्थ काम फलाय राज्याय नमः।

ऐसा ज्ञात होता है जैसे वर्तमान कल्याण राज्य के आदर्श को इस सूक्ति में टांक दिया गया हो। सोमदेव ने इसके बाद धर्म की परिभाषा करना उचित समझा—धर्म वह है जिससे यह लोक और परलोक दोनों सिद्ध हो सकें। यह भारतीय दर्शन की जानी-पहचानी

मान्यता थी, जिसे सभी नीतिशास्त्रों ने अपना आधार बनाया। जितना भी राजकीय विधि-विधान है उसकी नींव की भांति यह सूत्र है—सर्व सत्त्वेषु हि समता सर्वाचरणानां परमाचरणम् (१।४) अर्थात् सब प्राणियों के प्रति समता का भाव यही सब आचरणों में श्रेष्ठतम है। किसी भी भूत का द्रोह नहीं करना चाहिए। मनुष्य किसी व्रत का साधन न भी करे तो कोई हानि नहीं, पर दूसरों के प्रति चित्त में द्रोह का भाव नहीं रखना चाहिए (१।६)। जीवन में व्रतों का पालन भी एक कर्तव्य है। किन्तु व्रत या नियम वही अच्छा है जिससे शरीर और मन इन दोनों को संशय में न डालना पड़े, अर्थात् इनसे लड़ाई न लड़नी पड़े। अपात्रों में धन का व्यय भस्माहुति के समान है (१।११)। ईश्वर न करे किसी के पास ऐसा धन एकत्र हो जिसमें शरणागतों को भाग न दिया जाय (१।१४)। दरिद्र का कोई बन्धु नहीं होता। जो सदा याचना करता है वह अपने हितू को भी उद्वेग में डाल देता है। इन्द्रिय और मन इन दोनों से नियमों का अनुष्ठान ही तप है (इन्द्रियमनसोर्नियमानुष्ठानं तपः १।२०)। विहित का सेवन और निषिद्ध का त्याग नियम कहलाता है। जिसके मन और इन्द्रियों की वृत्तियां अनियमित हैं उसका सब करना-धरना हाथी के स्नान की भांति है (१।२४)। जो ज्ञान को अपने ही आचरण में नहीं लाता उसका ज्ञान ऐसा है जैसे कुरूप व्यक्ति का आभूषण पहनना। प्रतिदिन नियम पूर्वक कुछ दान और तप करना चाहिए (१।२७)। रत्ती-रत्ती जोड़ने से मेरु जैसा पर्वत बन जाता है (१।२८)। धर्म, ज्ञान और धन की एक-एक बूंद प्रतिदिन जमा करने से समुद्र बन जाता है (१।२९)। जो धर्म का पालन नहीं करता वह अपने को ही ठगता है (१।३०)। धर्म का फल देखते हुए भी जो अधर्म का आचरण करता है उससे बढ़कर मूर्ख कौन है? जैसे कोई कृषक बीज को ही खा डाले ऐसे ही अधार्मिक को भविष्य में सुख की आशा नहीं।

अर्थ, काम और धर्म-इन तीनों को साथ लेकर चलना ही बुद्धिमत्ता है। सोमदेव का कथन है कि जो अर्थ और काम को छोड़कर केवल धर्म का ही आग्रह करता है वह मानों पके हुए खेत को छोड़कर जंगल में बीज बोने जाता है।

दूसरे अर्थ-समुद्देश में धन का महत्व, उपार्जन, रक्षण, वृद्धि और दान आदि के विषय में बहुत ही सुन्दर नीतिवाक्य कहे गये हैं। जीवन में अर्थ का बहुत महत्त्व है—यतः सर्व प्रयोजन सिद्धिः सोऽर्थः,—जिससे मानव के सब प्रयोजन सिद्ध होते हैं वह धन है। जिसे कृपण गाड़कर रक्खे वह धन नहीं, (२।१) वही धन का योग्यपात्र है जो धन से धन का उपभोग करता है। जो धन के पात्र हैं उनका धन से सम्मान न किया जाय तो वह धन छत्ते में संचित शहद की तरह नष्ट हो जाता है (२।४)। जो धर्म का कार्य करते हैं और जो लोकहित का कोई कार्य उठाते हैं उन्हें धन का योग्य पात्र मानना चाहिए।

तीसरे अध्याय में काम का वर्णन है। धर्म और अर्थ का जिससे विरोध न हो ऐसे काम का सेवन करने से व्यक्ति सुखी होता है (३।२)। धर्म, अर्थ, काम इन्हें त्रिवर्ग कहते हैं। इन पर बराबर ध्यान देना चाहिए (३।३)। एक में अति करने से दो बिगड़ जाते हैं और अपने लिये भी दुःख निकलता है (३।४)। सच्ची विभूति या सम्पत्ति वही है जिससे इन्द्रिय और मन दोनों प्रसन्न हों, (३।६)। जिसने इन्द्रियों को नहीं जीता उसका कोई काम सिद्ध नहीं होता (३।७)। जिस राजा को काम ने जीत लिया वह बलवान

शत्रुओं को क्या जीतेगा (३।१०)। जो काम के फंदे में फंसा उसका इलाज नहीं (३।११)। धर्म, अर्थ और काम इनमें पूर्व–पूर्व का अधिक महत्व है।

चौथे समुद्देश में काम, क्रोध, लोभ, मद, मान और हर्ष–इन्हें अन्तरंग शत्रु कहा गया है, अर्थात् ये अपने शरीर में ही रहते हैं कहीं बाहर से नहीं आते। बिना कारण दूसरे को दुःख देकर खुश होना मिथ्या हर्ष कहलाता है (४।७)।

पाँचवें समुद्देश में विद्यावृद्ध लोगों के लक्षण और कर्तव्य कहे गये हैं। विद्यावृद्ध से तात्पर्य मंत्री, उपाध्याय, आचार्य और पुरोहित जैसे लोगों से है जिनका सम्मान और आदेश पालन करना राजा के लिये भी योग्य है। यदि राजा अपने को इनके वशवर्ती रक्खेगा तो वह पथभ्रष्ट होने से बचा रहेगा। दुष्टों को दण्ड ओर शिष्टों की रक्षा–यही राजा का धर्म है। सिर मुड़ाना या जटा रख लेना राजा के लिये अधर्म है। पृथिवी का पालन करने के लिये जो उचित कर्म है उसे ही राज्य कहते हैं। पृथ्वी वह है जहां अन्न, सुवर्ण, पशु और वृष्टि उपलब्ध हों और आश्रम के धर्मों का पालन होता हो। इसके अनन्तर ब्रह्मचारी, गृही, वानप्रस्थ और यति–इन चार आश्रमों के कर्तव्यों का वर्णन किया गया है। जो विवाह करके पत्नी के साथ घर में निवास करता है वह गृहस्थ है।

उत्तराधिकार में प्राप्त और अपने पराक्रम से विजित, दो प्रकार का राज्य होता है (५।२६)। जो राजा स्वयं बुद्धिमान् होता है या अपने अमात्यों की बुद्धि के अनुसार वरतता है उसी के पास राज्य टिकता है (५।३०)। विद्या से जिसकी बुद्धि विनीत या शिक्षित हुई हो वह बुद्धिमान् कहलाता है (५।३२)। शेर की तरह केवल पौरुष या बल का सहारा लेने वाले की देर तक कुशल नहीं होती। जो बात आंख से न दिखाई पड़े उसे दिखाने वाला तीसरा नेत्र शास्त्र होता है। आंख वाला मनुष्य भी बिना शास्त्र पढ़े अन्धा ही रहता है (५।३५)। मूर्ख से बढ़कर और पशु नहीं (५।३६)। अराजक राज्य अच्छा, मूर्ख राजा अच्छा नहीं। दुर्विनीत राजा के द्वारा प्रजाओं के नाश से बढ़कर और उत्पात नहीं। क्या ठीक है और क्या ठीक नहीं, इसका जिसे पता नहीं उसे अविवेकी कहते हैं। वही दुर्विनीत होता है। बुद्धि के आठ गुण हैं—शुश्रूषा, श्रवण, ग्रहण, धारण, विज्ञान, ऊह, अपोह, तत्त्वाभिनिवेश (५।४४)। जिस राजा का विद्यावृद्ध लोगों से सम्पर्क नहीं हुआ वह निरंकुश हाथी के समान नष्ट हो जाता है (५।६०)। राजा स्वयं न पढ़ा होने पर भी यदि विद्वानों का सम्पर्क करता है तो उसमें भी समझदारी आ जाती है (५।६३)। जो शिष्टों से झुक कर चलता है वह इस लोक में और उस लोक में भी बड़ाई पाता है (५।६६) मूर्ख रहना अच्छा, पर दुर्जन की सेवा से विद्या प्राप्त करना अच्छा नहीं (५।६८)। विष मिले हुए अमृत का न मिलना ही अच्छा। यदि राजा गुण का सम्मान करता हो तो मंत्रियों को चाहिए कि सच्ची खरी बात कहें (५।७४)।

छठे समुद्देश में आन्वीक्षिकी, सातवें में त्रयी, आठवें में वार्ता और नवें में दण्डनीति इन चार प्रसिद्ध विद्याओं की व्याख्या की गई है और उनके द्वारा कर्तव्य-पालन का उपदेश दिया गया है। आन्वीक्षिकी अध्यात्म विद्या है। त्रयी के अन्तर्गत वेदों की परम्परा, मन्वादि स्मृतियों की परम्परा और तदनुसार वर्ण और आश्रमों के धर्मों और अधर्मों की व्यवस्था का ग्रहण किया जाता था। ऊँच-नीच सब प्रकार के लोग अपने-अपने धर्म का

उसी तरह पालन करें जैसे सब एक समान सूर्य का दर्शन करते हैं (आदित्यावलोकनवत् धर्मः खलु सर्वसाधारणः विशेषानुष्ठाने तु नियमः, ७।१४)। जो प्रजा की रक्षा न करे वह कैसा राजा (७।२१) ? प्रजाओं का परिपालक राजा उनके पुण्य का छठा अंश पाता है। यदि राज्य में किसान कुपित हों तो उन्हें तकावी आदि ऋण बांटकर शान्त करना चाहिए (७।४०)। खेती, पशु पालन और वाणिज्य इन्हें वार्ता कहा गया है। यदि वार्ता की समृद्धि है तो और समृद्धियाँ राजा को स्वतः मिल जाती हैं। उसको सब संसार का सुख है जिसके घर खेती, दुधार गाय, साग–सब्जी का बगीचा और पानी का कूआँ हो—

"तस्य खलु संसारसुखं यस्य कृषिर्धेनवः शाकवाटः सद्मान्युद्पानञ्च, (८।३)"।

जो धन का संग्रह नहीं करता उसके यहाँ सदा दुर्भिक्ष रहता है। यदि समुद्र ही प्यासा हो जाय तो उसकी प्यास किस जल से बुझेगी (८।७) ? बूढ़े, बालक, रोगी और कमजोर पशुओं को अपने भाई–बन्धु के समान पुष्ट करें (८।९)। अपनेराज्य में चुंगी बढ़ा देने से या जबर्दस्ती कम मूल्य में माल खरीद लेने से देशान्तर से आने वाला माल कम पड़ जाता है। कठौते में एक ही वार वस्तु रांधी जाती है (काष्ठपात्र्यामेकदैव पदार्थो रध्यते, ८।१२) जो राजा लेवा-बेची की अन्धाधुन्धी पर ध्यान नहीं देता उसका सब कुछ बंटाढार हो जाता है (८।२०)। अगर राजा कड़ाई से अपने नियमों का पालन करावे तो चोर, उचक्के, ठग, बेईमान आदि राष्ट्रकंटक पैदा ही नहीं होते। राज्य को दोषों से मुक्त करने वाला दण्ड होता है (९।१)। प्रजापालन के लिए राजा को दण्ड का विधान करना चाहिए, धन के लिये नहीं। अर्थ दण्ड या जुर्माने से मिले धन को राजा अपने काम में न ले। राजा दण्ड का विधान न करे तो, छोटी मछली को बड़ी मछली की तरह, निर्बल को बलवान् खा डालें।

दसवें मन्त्रि-समुद्देश नामक अध्याय में मन्त्रियों के महत्व और कर्तव्य का उल्लेख है। जो युक्तिसंगत मंत्र का उपदेश करे वही बुद्धिमान् मंत्री है। कहा जाता है कि विष्णु गुप्त के अनुग्रह से अनधिकृत चन्द्रगुप्त ने साम्राज्य-पद प्राप्त किया। मंत्री ऐसा होना चाहिए जो अपने ही देश का हो, आचारवान् हो, कुलीन हो, और सब व्यवहार शास्त्रों का जानने वाला हो (१०।५)। सब पक्षपातों में स्वदेश का पक्षपात सबसे प्रबल होता है (समस्तपक्षपातेषु स्वदेश पक्षपातो महान्, १०।६)। विष की मिलावट की तरह दुराचार सब गुणों पर पानी फेर देता है (१०।७)। जो विपत्ति में साथ न दे वह कोई भी हो उससे क्या मतलब (१०।१०) ? जो मंत्री राजा का प्रतिरोध न कर सके वह ऐसा ही है जैसा घड़े में रक्खा दीपक (१०।१८)। उनका शास्त्र निष्फल है जिनके चित्त में शत्रु के दर्शन से भय उत्पन्न हो जाय। गलिया बैल को कोई भी बोझ ढोने के काम में नहीं लगाता (१०।२१)। राजाओं के सब काम मंत्रियों के साथ मंत्रणा करने के बाद होने चाहिएँ (१०।२२)। जिस विषय में मंत्रणा की जा चुकी है फिर उसके संपादन में दीर्घसूत्रता न करनी चाहिए (उद्धृतमंत्रो न दीर्घसूत्रः स्यात्, १०।४२)। मंत्र का अनुष्ठान ही महत्वपूर्ण है, औषधि जान लेने मात्र से रोग दूर नहीं हो जाता (१०।४४)। अविवेक से बढ़कर शत्रु नहीं है, स्वामी का सहारा पाकर भेड़ भी सिंह हो जाती है

(१०।४८)। मंत्र का फल यह है कि लघु उपाय से महान् कार्य की सिद्धि हो। राजा का दुःखी हो जाना अच्छा किन्तु मंत्री द्वारा अकार्य वस्तु का उपदेश देकर राजा का नाश कराना ठीक नहीं। राजा की ह्रास-वृद्धि को मंत्रियों की घटती बढ़ती समझनी चाहिए। वह राजा नहीं जो मंत्रियों की बात न मान कर काम करे (१०।५८)। भली प्रकार विवेचित मंत्र से कार्य-सिद्धि होती ही है। मंत्र द्वारा सोचा हुआ कार्य नीति से सिद्ध होता ही है (१०।६१)। चाहे माता में विकृति आ जाय, पर भली प्रकार अनुष्ठित नीति नहीं बिगड़ती। हित की प्राप्ति और अहित का निवारण पुरुषार्थ से ही होता है। जो काम टाला नहीं जा सकता उसमें आज-कल नहीं करना चाहिए (१०।६३)। समय बिता देने से नखच्छेद्य कार्य कुठारच्छेद्य बन जाता है।

राजा की मंत्रिपरिषद् में कितने मंत्री होने चाहिए यह प्राचीन राजनीति का महत्वपूर्ण प्रश्न था। इस पर भी सोमदेव ने विचार किया है। उनका निश्चित मत है कि राजा एक मंत्री पर निर्भर न रहे (१०।८१)। राजा को चाहिए कि पहिले से ही गुणी व्यक्तियों का संग्रह करके रक्खे। वक्त पर अच्छे आदमी नहीं मिलते (१०।८३)। घर में आग लग जाने पर कूआँ खोदने से क्या लाभ? पुरुष-संग्रह से धन का संग्रह घटकर है (१०।८५)। बुद्धि, धन और युद्ध सम्बन्धी कार्यों में जो सहायक हो सकें येही सच्चे कार्य, पुरुष कहलाते हैं, नहीं तो खाने की पंगत में शामिल होकर कौन सहायता नहीं कर सकते (१०।८८)? मूर्ख को मंत्र देने का अधिकार नहीं है। क्या अन्धा कभी देख सकता है? मूर्ख की सलाह से काम का बन जाना अन्धे के हाथ बटेर लगने के समान है। मूर्ख से ठीक सलाह मिलना घुणाक्षरन्याय का संयोग है (१०।९३)। स्वामी किसी पर प्रसन्न हो तो उसे धन मिल सकता, कुलीनता और पाण्डित्य नहीं। मूर्ख को राज्य सौंपना ऐसा है जैसे अपनी मृत्यु के लिए कृत्या का विचार। जिसे व्यवहार की बुद्धि नहीं है उसके लिए पोथी पत्रे के ढेर भी किस काम के जो शस्त्र के अधिकारी हैं उन्हें मंत्र का अधिकार नहीं देना चाहिए। शस्त्रजीवियों को झगड़े के बिना खाया हुआ अन्न भी नहीं पचता (१०।१०३)। ऐसा सरकारी अफसर मिलना मुश्किल है जो लम्पट न हो (नालम्पटो-ऽधिकारी, १०।१०५)। यदि मंत्री ही धन का आचमन करने लगे तो राज्य का क्या काम होगा (१०।१०६)? यदि बटलोई ही भात को खाने लगे तो खाने वाले को भोजन कहां से मिलेगा? एक बार जो चित्त टूट गया तो बिल्लौर के शीशे की तरह उसे कौन जोड़ सकता है? कितनी भी भलाई करो चित्त में वैसा अनुराग पैदा नहीं होता जैसा थोड़ी बुराई से उद्वेग हो जाता है (१०।११२)। धन मिलता हो तो किसे लोभ नहीं ग्रस लेता (१०।११७)? जो पराये धन और पराई स्त्री में अपना चित्त निःस्पृह रखता है उसे साक्षात् देवता समझना चाहिए (१०।११८)। दोष के डर से कायर पुरुष काम ही नहीं शुरू करते। क्या हिरणों के डर से खेती छोड़ देनी चाहिए? क्या अजीर्ण के डर से भोजन त्याग देना चाहिए? क्या कोई ऐसा काम हुआ है, या होगा जिसमें विघ्न न हो? बड़ों की बातचीत क्षीरी वृक्ष की तरह फल प्राप्त कराने वाली होती है (१०।१३२)। जो विपत्ति में धैर्य धारण करता है वही महान् है (१०।१३२)। पुरुष का व्याकुल हो जाना कार्य का पहला विघ्न है। स्वभाव से कोई वस्तु सुन्दर या असुन्दर नहीं होती। जो

जिसे भाती है वही उसके लिए सुन्दर है (१०।१३५)। क्षणिक चित्त वाला व्यक्ति कुछ भी नहीं साध पाता (१०।१४१)। जो आलसी है वह सब कामों के लिए निकम्मा है (१०।१४३)। नदी का वेग पेड़ों के चरणों को धोता हुआ भी उन्हें उखाड़ देता है। जो कार्य साधने में सहायक न हो उसके आने से न आना ही अच्छा। छोटा झरोखा भी सारा रहस्य खोल देता है। नीति से हीन बढ़ती भी ऐसी ही है जैसे बुझती हुई दिये की लौ। (१०।१६०)। राजा के लिए सब प्रकार के विघ्नों से अपनी प्रजा का कोप सबसे अधिक भयंकर होता है (सर्व कोपेभ्यः प्रकृतिकोपो गरीयान्, १०।१९१)। इस प्रकार इस लम्बे अध्याय में सामान्य और विशेष नीति के अनेक ऐसे सिद्धान्त बताए गए हैं जो व्यावहारिक जीवन में बुद्धि के द्वारा काम में लाए जाते हैं।

ग्यारहवें समुद्देश में पुरोहित, बारहवें में सेनापति, तेरहवें में दूत, चौदहवें में गुप्तचर, पन्द्रहवें में विचार, सोलहवें में व्यसन, सत्रहवें में राजा और अठारहवें में अमात्य के कर्तव्य और गुण-दोषों का विचार किया गया है। ये विषय प्राचीन भारतीय राज-शास्त्र में प्रायः विस्तार से मिलते हैं। उन्हीं का सार सोमदेव ने लिया है। मंत्री के समान ही पुरोहित का भी ऊँचा पद था। मंत्री और पुरोहित को राजा का माता-पिता कहा गया है। इसी प्रसंग में कुमार अर्थात् राजपुत्रों के यथावत् शिक्षण की भी चर्चा की गई है। कुमारों को लिपि, गणित, व्याकरण, साहित्य, नीति, रत्न, कामशास्त्र, युद्ध-वाहन आदि विषयों की सम्यक् शिक्षा देनी चाहिए। पुरोहित ही राजा का गुरु भी होता था और दोनों का संबंध बहुत ही घनिष्ट माना जाता था। यदि राजा अधिक बुद्धिशाली हो तो भी गुरु का अपमान नहीं करना चाहिए।

विचार समुद्देश का मूल सूत्र यह है कि बिना विचारे कोई काम नहीं करना चाहिए (नाविचार्य किमपि कार्यं कुर्यात्, १५।१)। बिना विचारे जो काम कर दिया पीछे उसका उपाय करना ऐसा ही है जैसा पानी बह जाने के बाद बांध बांधना (१५।८)।

स्वामी-समुद्देश के अन्तर्गत राजा के गुण, स्वभाव और प्रभविष्णु व्यक्तित्व क. वर्णन किया गया है। राजा के ऐश्वर्य का अर्थ है कि लोग उसकी आज्ञा मानें (आज्ञाफलमैश्वर्यम् १७।२२)। आज्ञा भंग करने वाले पुत्र को भी न सहना चाहिए (१७।२६)। जिसके हुक्म की शान नहीं उस राजा में और चित्र में क्या अन्तर? राजा की आज्ञा वह दीवार है जिसे कोई लांघ नहीं सकता। राजा को चाहिए कि प्रजा का काम स्वयं देखे (प्रजा कार्यं स्वयमेव पश्येत्, १७।३६)। सरकारी अफसर राजा के दोष बढ़ा कर अपना उल्लू ऐसे सीधा करते हैं जैसे वैद्य रईसों के मर्ज बढ़ाकर (१७।३९)। घूसखोरी अदालत में आने वाले को जड़ मूल से काटती है (कार्यार्थिनो लञ्चो लुञ्चति, १७।४०)। घूसखोरी सब ऐबों को राह देने का फाटक है (लञ्चो हि सर्व पातकानां आगमनद्वारम्, १७।४२)। घूसखोर मांता की दूधी को भी नोच खाता है (१७।४३)। घूस लेकर काम करने वाले अफसर मालिक को भेड़ की तरह सस्ते में कटने के लिये बेच डालते हैं। जब राजा ही घूस लेकर काम करने लगे तो किसका भला हो सकता है। देवता ही यदि चोरों से मिल जाएँ तो लोगों की कुशल कहां? राजा यदि अन्याय करने लगे तो ऐसा ही समझिए जैसे समुद्र अपनी मर्यादा छोड़ दे, या सूर्य का अंधेरे को बढ़ाना या मां का स्वयं अपने ही बच्चे को खा लेना

(१८।४९)। राजा ही काल का निर्माण करने वाला है। यदि वह न्याय से प्रजा का पालन करें तो लोगों के लिए चारों दिशाएँ कामदुघा बन जाती हैं, समय पर जल बरसने लगता है और सब ईति-भीति शान्त हो जाती हैं। जो गरीब किसान कुटुम्बी हों उन्हें जमा पूंजी देकर बसाना चाहिए (१७।५३)। समुद्रपर्यन्त फैली पृथिवी राजा का कुटुम्ब है, स्त्रियां तो वंश चलाने का साधनमात्र हैं (१७।५४)।

अमात्य समुद्देश में बताया गया है कि अमात्य में क्या गुण होने चाहिए और किस प्रकार के व्यक्ति का चुनाव राजा को करना चाहिए। कहा है कि जहां तक संभव हो अपने संबंधी नातेदार या मित्र को अधिकार पद नहीं सौंपना चाहिए। इसी प्रसंग में आय-व्यय या हिसाब-किताब रखने के विषय में सरकारी दफ्तरों में काम करने वाले लेखकों के विषय में, सरकारी कर्मचारियों को ईमानदारी की सीमा में रखने के विषय में एवं धान्यादि का संचय करने के विषय में भी कुछ अच्छे नियम कहे गए हैं। जितनी आय हो और जितना व्यय हो उन दोनो को ले-देकर और जो द्रव्य राज्यकोष में बचे उसे नीवि कहते हैं। सरकारी दफ्तरों के रजिस्टरों में नीवि का दर्ज करना उसके बाद उस पुस्तक या रजिस्टर को जमा करा देना—इतनी कार्यवाही होने पर आय-व्यय के हिसाब की जांच होती थी। यदि आय-व्यय के हिसाब में कुछ अन्तर हो तो चतुर करण (क्लर्क) और कार्य पुरुषों (सुपरिन्टेंडेण्ट) द्वारा हिसाब का विनिश्चय कराना चाहिए। सब संग्रहों में धान्य का संग्रह श्रेष्ठ है। पुराने संचय की जगह नया रखकर पुराने का व्यय कर डालना चाहिए (१८।७०)।

अवशिष्ट या बचे हुए समुद्देश इस प्रकार हैं:—१९-जनपद, २०-दुर्ग, २१-कोश, २२-बल, २३-मित्र, २४-राजरक्षा, २५-दिवसानुष्ठान, २६-सदाचार, २७-व्यवहार, २८-विवाद, २९-षाड्गुण्य, ३०-युद्ध, ३१-विवाह, ३२-प्रकीर्ण।

जनपद समुद्देश राष्ट्र के भौतिक स्वरुप की दृष्टि से महत्वपूर्ण हैं। मध्यकालीन साहित्य में जनपद और राष्ट्र पर्यायवाचक माने जाते थे। सोमदेव की दृष्टि में जनपद वह है, जहां वर्ण और आश्रम का पालन करने वाला जनसमुदाय बसता है, जिसमें अनेक प्रकार के द्रव्य या पदार्थ उत्पन्न होते हैं, जहां लोग एक दूसरे की रक्षा करते हैं, जिसमें खनिज सम्पत्ति, लकड़ी, हाथी आदि के स्रोत हो, जहां न बहुत छोटे न बहुत बड़े ग्राम या या नगर हों, जिसमें बहुत तरह के कीमती धान्य और पण्य उत्पन्न होते हैं, जिसमें मनुष्य के प्रबन्ध से खेतों की सिंचाई होती हो, जो मनुष्यों और पशुओं के लिये हितकारी हो, जिसमें कारीगरों की श्रेणियां और किसानों की आबादी हो (१९।५८)। कहना चाहिए कि इस परिभाषा में सोमदेव ने बहुत दूर तक सोच समझकर अच्छे जनपद के गुणों की एक लड़ी गूंथ दी है। प्रजाओं को किसी भी तरह की बाधा पहुंचे तो उसका प्रभाव कोष पर पड़ता है। राज्य द्वारा बाँधे हुए पुश्तैनी बंधेजों का जब उल्लंघन किया जाता है तो उपजाऊ धरती भी उजाड़ हो जाती है (मर्यादातिक्रमेण हलवत्यपि भूमि भवत्यरण्यानि, १९।१९)। प्रजाओं के वर्धन का उपाय यह है कि जो क्षीण कुटुम्बी या किसान हैं उन्हें पूंजी उधार दी जाय। किसी के एक तिनके या सीक को भी राजा स्वयं न ले और कभी-कभी कुछ थोड़ा सा कर प्रजाओं से लिया जाय। इन तीन उपायों से क्षीण हुई प्रजा पुनः आबाद हो जाती है।

राज्य में जो पैंठ या चुंगी के स्थान हैं और जहां बाहर से आए माल की गाठें खोली जाती हैं उनकी भी राजा को न्याय से रक्षा करनी चाहिए, अर्थात् अधिक शुल्क नहीं लेना चाहिए, तब ये चुंगियां राज्य के लिये कामधेनु बन जाती हैं।

दुर्ग समुद्देश नामक बीसवें अध्याय में दुर्ग निर्माण का महत्व बताया गया है। बिना मुद्रा के किसी को दुर्ग में आने-जाने की आज्ञा न देनी चाहिए। यहां दो ऐतिहासिक दृष्टान्त दिए गये हैं। एक हूणाधिपति या हूण राजा का जिसने सौदागरों के वेश में चित्र-कूट या चितौड़ के दुर्ग में सैनिक भेजकर उस पर कब्जा कर लिया था। इससे यह ज्ञात होता है कि चितौड़ का दुर्ग सोमदेव से कई शती पहले हूणों के आक्रमण के बाद बन चुका था। राजस्थान में अभी तक हूण क्षत्रिय पाए जाते हैं जो हूण आक्रमण के समय में वहां आबाद हुए होंगे। दूसरा उल्लेख यह है कि कांचीपुरी के भद्र नामक राजा के दुर्ग में शत्रु ने अपने लड़ाकू सैनिक भेजकर उसका राज्य छीन लिया। यह घटना भी ऐतिहासिक ज्ञात होती है। प्रसिद्ध है कि चालुक्य नरेश विक्रमादित्य प्रथम ने ६७४ ई० के लगभग पल्लव नरेश को हराकर काञ्ची पर अधिकार कर लिया था।

कोश समुद्देश में कहा गया है कि कोश ही राजाओं का सच्चा जीवन है, प्राण जीवन नहीं (कोशो हि भूपतीनां जीवनं न प्राणाः, २१।५)। कोश ही राजा है शरीर राजा नहीं (कोशो हि राजेत्युच्यते न भूपतीनां शरीरम्, २१।७) उस तालाब के बड़े होने से क्या जिसमें जल नहीं ? राजा को सौम्य उपाय से ही कोश की वृद्धि करनी चाहिए।

बल समुद्देश के अन्तर्गत हाथी और घोड़ों का विशेष वर्णन किया गया है, जैसा राष्ट्रकूटों के युग तक प्रायः प्रत्येक साहित्य ग्रन्थ में मिलता है। यह ध्यान देने योग्य है कि सोमदेव ने घोड़ों के संस्कृत नाम ही दिए हैं, अरबी नहीं जैसा हेमचन्द्र ने बारहवीं शती में दिया है (२२।१०)। अरबों के लिये ताजिक शब्द आया है। राजा को उचित है कि उत्साह पूर्वक सेना का संगठन करे और अपने हाथ से स्वयं धन दे।

राजा की रक्षा और दिनचर्या के विषय में भी बहुत उपयोगी सूचनाएं संगृहीत की गई हैं। दिवसानुष्ठान समुद्देश या दिनचर्या के अन्तर्गत कहा गया है कि जब भूख लगे वही भोजन का उचित समय है (बुभुक्षाकालो भोजन कालः)। बिना भूख खाया हुआ अमृत भी विष हो जाता है। जठराग्नि को वज्राग्नि बनाना चाहिए। भोजन के आरम्भ में जलपान या रसाहार लेने से अग्नि क्षीण होती है। एक बार ही बहुत सा जल उँड़ेल लेने से भी वही फल होता है (२५।३५)। भूख के समय यदि न खाया जाय तो अन्न में अरुचि और देह शिथिल हो जाती है। आग बुझ जाने पर फिर इन्धन से क्या लाभ ? जो नियताहार करता है वह मानो आहार का पूरा मजा लेता है (यो मितं भुंक्ते स बहु भुंक्ते)। भोजन की मात्रा का कोई सिद्धान्त नहीं, वह तो अग्नि बल के अधीन है (न भुक्ति परिमाणे सिद्धान्तोऽस्ति वह्न्यभिलाषायत्तं हि भोजनम् २५।४३-४४)। इसी प्रकरण में यह भी कहा है कि अर्हत्, ब्रह्मा, विष्णु, शिव, बुद्ध और सूर्य एक ही देव के विशेष नाम हैं (२५।६८)। मनुष्यों को उचित है कि अपनी सुविधा के अनुसार दिन और रात के कार्यों का बँटवारा कर लें। जो समय का पालन नहीं करता उसके लिये कार्य का अनुष्ठान मरण तुल्य हो जाता है। जो काम अवश्य करना हो उसमें समय नहीं बिताना चाहिए।

छब्बीसवें सदाचार समुद्देश में अनेक उपयोगी उपदेशों के अन्तर्गत कहा गया है कि व्याधिग्रस्त के लिये धैर्य से बढ़कर औषधि नहीं (२६।७)। वह बड़भागी है जिसे कभी निन्दा की चोट नही लगी (२६।८)। चिन्ता से अर्थ नहीं मिलता, उत्साह से मिलता है। अपने स्वभाव को न जानकर किया हुआ पराक्रम किसे दुःख नहीं देता (२६।३२)? जिनकी इस लोक में स्थायी कीर्ति है वे मरते नहीं (२६।३१)। आय के अनुरूप व्यय करना चाहिए। प्रजा पालन ही राजाओं का यज्ञ है (२६।६६)।

सताइसवें व्यवहार समुद्देश में व्यवहार या कानून संबंधी कुछ नियम कहे हैं। जिस सभा में विद्वान् नहीं वह जंगल है। जो एक ही स्त्री से शादी करता है वही सुखी है।

षाड्गुण्य समुद्देश का संबंध विशेषतः राजनीति की पारिभाषिक शब्दावली से है। युद्ध समुद्देश का एक सूत्र स्मरणीय है—पंडितों की बुद्धि ही अमोघ शस्त्र है (प्रज्ञा ह्यमोघं शस्त्रं कुशलबुद्धीनाम् ३०।८)। प्रज्ञा से मारा हुआ वज्राहत की तरह फिर नहीं पनपता। थोड़े से चुने हुए आदमी अच्छे, बहुत सी मुंडमंडली जुटाना ठीक नहीं (३०।१६) अपनी शक्ति को न जानकर उत्साह दिखाना चट्टान से सिर टकराने के समान है। यदि अन्न न भी मिले और जल मिलता रहे तो भी शरीर में बल और प्राण बना रहता है। अपने स्थान पर ही व्यक्ति बलवान रहता है। वन से बाहर आकर सिंह भी शृगाल बन जाता है (१०।३६)। दांत उखाड़ा हुआ सांप रस्सी की तरह हो जाता है। नीतिशास्त्र के दो उद्देश्य हैं, पहला अपने मंडल का पालन और दूसरा परमंडल की उपलब्धि। नीति युक्त वाणी को सरस्वती का प्रत्यक्ष रूप समझना चाहिए—नयोदिता वाग् वदति सत्या ह्येषा सरस्वती (३०।८१)।

इस प्रकार नीति के अनेक अमृत तुल्य उपदेशों से यह ग्रन्थ आद्योपान्त भरा हुआ है।

पृथ्वी की आयु

केदारदत्त जोशी

इस सृष्टि का आविर्भाव आज से कितने वर्ष पहले हुआ है इसके सटीक शुद्ध आंकड़े हम अपने गणित ज्यौतिष सिद्धान्त से अच्छी तरह जान सकते हैं। अपने त्रिविध ज्यौतिष में मुख्यतः समय के दो भाग मिलते हैं। समय का दूसरा नाम काल है। एक तो वह काल है जिसे शास्त्रों में यमराज का अनुयायी कहा गया है और यही काल सर्वभूत संहार शक्ति का भी है। किसी भी क्षण में वह समग्र जड़, चेतन, प्रकृति, पुरुष आदि सबका विलय कर सकता है इसी को प्रलय क्षण या प्रलय काल कहा गया है। इसे जानने के (गणित, फलित) जैसे ज्यौतिष शास्त्र में अनेक साधन हैं जो प्रायः सटीक सत्य हैं अथवा तपस्वी जनों की दिव्य दृष्टि से भी यह जाना जा सकता है। किन्तु यह काल महान् से महान् हैं, शक्ति की चरम सीमा इसी में निहित है इसे जानने वालों को भी यह कवलीकृत कर देता है।

दूसरे अर्थ में काल को कलनात्मक अर्थात् गणनात्मक कहा गया है। इस गणनात्मक काल के भी स्थूल सूक्ष्म रूप से दो भेद कहे गये हैं। जैसे ६० सेकेण्ड का १ मिनट होता है तो एक सेकेण्ड का भी ६० वां भाग या उसका भी शतांश या सहस्रांश कुछ कहने को हो सकता है किन्तु उसकी अनिर्वाच्य सत्ता है। अतः यह सूक्ष्म काल हुआ और इसकी अपेक्षा सेकेण्ड कुछ स्थूल हुआ। सूक्ष्मकाल के सूक्ष्माति सूक्ष्म अवयव की अवश्य कोई सत्ता है, इसकी भी कोई संज्ञा होनी चाहिए अतः यह कुछ भी नहीं है अनिर्वाच्य पदार्थ है ऐसा कहते हुए यही शून्य है, शेष है। जहां से हम इस सूक्ष्मातिसूक्ष्य अवयव को ग्रहण कर सकते हैं उसे शास्त्रकारों ने त्रुटि नाम कहा है। सुई से कोमल कमल के पत्ते को छेदने में जितना समय लगे उसे त्रुटि (सूच्याभिन्ने पद्मपत्रे त्रुटिरित्यभिधीयते) कहते हैं। उसके आगे ६० त्रुटि = १ रेणु। ६० रेणु = १ लव = १ लीक्षा। ६० लीक्षा = १ प्राण। ६ प्राण = १ विनाडी = १ पल = $\frac{२}{५}$ मिनट। ६० पल = (२४ मिनट) = १ घटी। तथा ६० घटी = २४ घण्टा = १ अहरोत्रा = दिन रात। यह नाक्षत्र दिन होगा। अहोरात्र शब्द के आदि और अन्त के अ और त्र वर्ण के लोप से होरा (Houra) घण्टा २४ = १ दिनरात यह सवीज सिद्ध हुआ। काल माप के ये सूक्ष्म अवयव हैं। कल्पना करिये कि उदय क्षितिज में एक नक्षत्र, और उसी धरातल निष्ठ नीचे की कक्षावृत्त में एक ग्रह, इन दोनों का प्रातः ५ बजे उदय देखा गया। फिर ठीक २४ घण्टे के बाद प्रातः ५ बजे नक्षत्र तो क्षितिज में आ गया किन्तु ग्रह कुछ मिनट बाद क्षितिज में आया-इससे बहुत सी गति परम्परा की जानकारियां हुई (यह विषयान्तर है समय पर स्पष्ट किया जावेगा) हां २४ घण्टा में—ग्रह की गति से उत्पन्न काल, यह सावन नाम का अहोरात्र अलग हुआ। इस प्रकार—३० नक्षत्रोदय का एक नाक्षत्र मास, तथा ३० सूर्योदय का सावन मास, ३० तिथि का चान्द्र मास, ३० अंश भोग काल का १ सौर मास इत्यादि कहना चाहिए। इसी

प्रकार १२ सौर मास का एक सौर वर्ष—या मानव वर्ष और १ सौर वर्ष का—देवताओं का एक अहोरात्र या ३६० सौर दिन का देवता और असुरों का एक दिन होगा। क्योंकि उत्तर तथा दक्षिण ध्रुव में रहने वाले देव या राक्षस या अन्य योनि के जीवों के लिये, हमारे मान के ६ महीने का दिन और ६ महीने की रात्रि होती है। यह सब गणित खगोल और भूगोल से स्पष्ट है। सूर्य सिद्धान्त में उक्त मत का स्पष्ट निर्देश किया गया है जो इस प्रकार है।

"लोकानामन्तकृत्काल: कोलोऽन्य: कलनात्मक:
स द्विधा स्थूलसूक्ष्मत्वान्मूर्तश्चामूर्त उच्यते
प्राणादि: कथितो मूर्त्तस्त्रुट्यादोऽमूर्त संज्ञक:
षड्भि: प्राणैर्विनाड़ी स्यात् तत्षष्ट्या नाडिका स्मृता
नाड़ीषष्ट्या तु नाक्षत्रमहोरात्रं प्रकीर्त्तितम्
तत्त्रिंशता भवेन्मास: सावनोऽर्कोदयैस्तथा
ऐन्दवास्तिथिमिस्तद्वत् संक्रान्तया सौर उच्चते
सुरासुराणामन्योन्य महोरात्रं विपर्ययात्
तत्षष्टि: षड्गुणा दिव्यं वर्षमासुरमेव च"

इत्यादि

मानव व्यवहार के सौविध्य के लिये अनेक मापदण्डों में सौर सावन नाक्षत्र और चान्द्र ये चार मान विशेष प्रचलित हैं। क्रान्तिवृत्त में समान २ विभागों की राशि संज्ञा है। एक वृत्त के निर्दिष्ट बिन्दु से (सायन मेषादि बिन्दु से) चलती हुई पृथ्वी पुनः जिस क्षण सायन मेषादि बिन्दु पर आवेगी तो एक सायन सौर वर्ष होगा। सौर वर्ष के अन्त में सावन दिनों की संख्या ३६५ दिन ६ घण्टा ९ मि० ११$\frac{३}{५}$ सेकेण्ड के तुल्य होती है। सूर्य सिद्धान्त में ९ मि० के स्थान पर १२ मि० ३६ से० उपलब्ध होती है। पृथ्वी के जितने भाग में सूर्य प्रकाश हो उतने में दिन और विपरीत भाग में प्रकाशाभाव से रात्रि प्रत्यक्ष है। भास्कराचार्य ने 'दिनं दिनेशस्य यतोऽत्र दर्शने तमी तमोहन्तुरदर्शने सति' से इसे विशेषतया स्पष्ट किया है।

सर्व ग्रास सूर्य ग्रहण में पृथ्वी और सूर्य के बीच में चन्द्रमा के आ जाने के कारण सूर्य चन्द्रमा की स्पर्श रेखाओं से व्याप्त जितना भूमंडल है वहाँ पर भी महान् अंधकार (सूर्य किरणों को, भूमि में अवरोधक चन्द्रमा नहीं आने देता) हो जाता है। आज से ४४० वर्ष पूर्व काशी में दिन में सूर्य ग्रहण हो जाने से अन्धकार छा गया था—हा हा कार मच गया था तथा ४०५ वर्ष पूर्व वलयाकार सूर्य ग्रहण से सूर्य के चारों तरफ वलय की तरह दीखा गया था—महामहोपाध्याय श्री सुधाकर द्विवेदी प्रणीत सूर्य सिद्धान्त की सुधावर्षिणी टीका में उक्त विषय उद्धृत है। इस कथन का यही तात्पर्य है कि प्रकाश का अवरोधक जो भी हो उसके प्रतिकूल दिशा में अन्धकार या रात्रि रहती है। पृथ्वी के विभिन्न स्थानों में, ८, १०, १२, २४ घण्टों की दिन तथा विपरीत २४, १२. १०, ८ घण्टों की रात्रि होती है। हमारे माप के ६ मास तक उत्तरी ध्रुव में दिन तथा दक्षिणी ध्रुव में ६ महीने की रात्रि होती है। हमारे गणित खगोल सिद्धान्त ग्रन्थों में कहा गया है कि पृथ्वी के जिन

भागों में सूर्य की क्रान्ति, (९०–अक्षांश) से अधिक रहने से वहां सदा दिन रहेगा। जिस देश में ७०° के तुल्य उत्तर अक्षांश है, वहां मिथुन और कर्क के समानान्तर धरातलनिष्ठ भू पृष्ठ के देशों में प्रायः २३ मई से २३ जुलाई तक सदा २३ नवम्बर से २३ जनवरी दो महीने तक विपरीत दक्षिण अक्षांश में रात्रि ही रहेगी। एवं जहां ९० के तुल्य अक्षाँश है (जैसे ध्रुवादि प्रदेश) वहां २३ मार्च से २३ सेप्टेम्बर तक सदा दिन विपरीत ध्रुव में रात्रि रहेगी। यह खगोल भूगोल के बुद्धिगम्य विनोद, गणितज्ञों के आनन्द के लिये श्री भास्कराचार्य ने अपनी सिद्धान्त शिरोमणि में विस्तृत रूप से किये हैं।

अपने पृष्ठ स्थान से हम ज्यों ज्यों ऊपर उठेंगे त्यों त्यों हमें पृष्ठ क्षितिज के नीचे गर्भ क्षितिज की ओर सूर्य दर्शन उदय से पूर्व होगा एवं अस्त भी वास्तविक अस्त के उपरान्त होगा। इस प्रकार नाड़ीवृत्त (Equater) के धरातल ही में आकाश की ओर पृथ्वी से उपर जांय तो और बड़ा दिन प्रतीत होगा। पर उत्तर वा दक्षिण क्रान्ति के गमन बिन्दु से भूबिम्व की स्पर्श रेखा अवश्य भू पृष्ठ स्थान से अनन्ताकाश तक असमानान्तर होने के कारण मिल जावेगी। इस योग बिन्दु पर का निवासी सहत सूर्य दर्शन करेगा। इसको निम्न प्रकार सहज से जाना जा सकता है।

∵ अक्षांश > २४° + कुच्छन्नकला (पृथ्वी के गर्भ और पृष्ठ क्षितिजों का अन्तर चाप) ∴ ९० — अक्षांश ∠ (९० — २४) + कुच्छन्न कला = अक्षांश कोटि ∠ (६६ — कु०क०) ∴ अक्षांश कोटि में + २४ ∠ ९० — कु०क० = कुच्छन्न कोटि से अतः अक्षांश कोटि में २४° जोड़ने से जो दृश्यांश हो वह कुच्छन्न कोटि से कम होने के कारण उस स्थान से सतत रविदर्शन होगा—गणक सार्वभौम भट्ट कमलाकर ने (१६ वीं शताब्दी) में अपने विशाल गणित ग्रन्थ सिद्धान्त तत्वविवेक में उक्त विषय—जिनाढय कुच्छन्नलवाधिकाक्षे, लम्बांश सिद्धांशकयोग तुल्यैः दृश्यांशकै रुक्तवदेव यत्स्यात्तंदृक्चिह्नकं स्वक्षितिजपृष्ठचिह्नात् यैर्योजनै स्तद्वशतोऽपि तत्र सदोदितोऽर्को भवतीति चित्रम् उद्धृत किया है। इसी की पुष्टि भास्कराचार्य जी के द्वारा सिद्धान्त शिरोमणि में की गई है जो इस प्रकार है—

'यदति दूर गतो द्रुहिणः क्षितेः सततमाप्रलयं रविमीक्षते'

अनन्त ब्राह्माण्ड के उस बिन्दु से सूर्य के सन्मुख भूबिम्ब के कुछ दूर पृथ्वी सूर्य बिम्ब को अच्छादित करती हुई एक वलयाकार के रूप में सूर्य दृष्टिगत होगा—आगे आकाश में बढ़ने पर पृथ्वी केवल एक बिन्दु मात्र सी सूर्य दर्शन की बाधिका होगी उससे भी आगे बढ़ने पर तो उस ब्रह्मनिष्ठ बिन्दु से सूर्य दर्शन में लेशमात्र कोई भी पिण्डबाधक नहीं है अतः वही सदा उदित सूर्य दृष्टिगत होने का ब्रह्माण्ड में एक नियत बिन्दु है इस स्थल पर पूर्व में दिन रात्रि की उपपत्ति के अवसर पर अक्षांश से विपरीत स्थिति कह आये हैं तो यही इसी अनन्त ब्रह्माण्ड में अवश्य कोई बिन्दु है जहां उक्त काल तक सूर्य दर्शन न हो। ये स्थिति तभी तक होगी जब तक इन नक्षत्र ग्रह पिण्डों में प्रकाश आदि की सत्ता हो। प्रकाश आदि के विलय होने के कारण समग्र ब्रह्मसृष्टि का भी विलय हो जाता है कभी कभी बीच बीच में भी खण्ड प्रलयादि की स्थिति उत्पन्न होती है—अपने शास्त्रों में प्रत्येक खण्ड प्रलय या अल्प प्रलय के विषय में कुछ संकेत दिये गये हैं।

जिस समय सब ग्रहों की स्थिति सूक्ष्मावयव से एक बिन्दु पर आयेगी उस समय महा-

प्रलय तथा जिस समय ३०°, या दो राशि, तीन राशि के अन्तर से उस समय खण्ड प्रलय योग हो सकता है।

प्राय: ग्रहों की गति के सामन्जस्य से ४३२००० वर्षों में पृथ्वी या सृष्टि में कुछ ऐतिहासिक परिवर्तन होते हैं जिनका प्रत्यक्षीकरण आज से ५०६२ वर्ष पूर्व ग्रह स्थिति बश पृथ्वी पर महाभारत का प्रचण्ड युद्ध से होता है, जो विश्व की क्षति कारक था। महाभारत की घटना कलियुग के आदि में हुई है। इन युगों के मापने की एक गणित प्रक्रिया सिद्धान्त गणित ग्रन्थों में उपलब्ध होती है। यथा प्रातः काल, उत्तम आचरण एवं विवेकपूर्ण मानवीय गुणों के लिये उपयुक्त है, मध्याह्न में प्राकृतिक परिवर्तन के कारण उक्त गुणों में ह्रास देखा जाता है। सायं विशेष ह्रास और मध्यरात्रि मोहनिशा में विवेक शून्यता एवं कुत्सित आचरण की अपेक्षा होती है अंकों द्वारा सहज रीति से समझा जा सकता है।

४+३+२+१=१० इस माप से यदि एक दिन की जिज्ञासा है तो

$\frac{४ \times २४ \text{ घं०}}{१०}$ =९ घं० ३६ मि० यह पूर्ण विवेकात्मक प्रातः काल।

$\frac{३ \times २४ \text{ घं०}}{१०}$ =७ घं० १२ माध्याहन का $\frac{३}{४}$ विवेकात्मक काल।

$\frac{२ \times २४ \text{ घं०}}{१०}$ =४ घं० ४८ मि०……… $\frac{१}{२}$ विवेकात्मक काल।

$\frac{१ \times २४ \text{ घं०}}{१०} = \frac{२ \text{ घं० } २४ \text{ मि०}}{२४ \text{ घं० } ० \text{ मि०}}$ $\frac{१}{४}$ विवेक तथा $\frac{३}{४}$ मोह अज्ञानात्मक काल

४३२००० कलियुग के वर्षों को विपरीत समीकरण से कलियुग मोहकाल

४३२०००×१ ४३२०००=कलियुग मोहकाल।

४३२०००×२ ८६४०००=द्वापर मोह और विवेक तुल्य।

४३२०००×३ १२९६०००=$\frac{३}{४}$ विवेक काल।

४३२०००×४ १७२८०००=सत्ययुग।

४३२०००० चतुर्युग योग। पूर्ण विवेक काल।

उक्त चतुर्युग के पृथक् २ वर्षों में खण्ड प्रलय के साथ सृष्टि में कुछ नवीनता ग्रहों के क्रम मार्ग की कम दूरी से आती है।

१००० महायुगों के एकीकरण के समय समग्र ग्रहों के पात, उच्च राशि आदि सब एक बिन्दु में आजाने से परस्पर संघर्षण, आकर्षण उर्ध्वाधर स्थान भ्रष्टता आदि के कारण महाविनाश काल उत्पन्न हो जाता है। अथवा ४३२००००×१०००=४३२०००००००० चार अरब, बत्तीस करोड़ वर्षों की आयु हमारे आचार्यों ने पृथ्वी की मानी है।

पुनः उक्त वर्ष घोर अन्धकार में रहकर ब्रह्मा नूतन सृष्टि का सृजन करता है तथा पूर्व में ब्रह्माण्ड का ब्रह्मनिष्ठ सदोदित रवि दर्शन निरन्तर करता है।

सम्प्रति सूर्य, चन्द्र, भौम, बुध इत्यादि ग्रहों की आकाशीय क्रान्ति वृत्तस्थ राश्यादि स्थिति का संकेत गणित के आधार पर देना अत्यावश्यक है।

पंचागों का निर्माण, सृष्टयादि से लेकर आज तक वर्ष मास, दिन की गणना करके अनुपात द्वारा ग्रह केन्द्र बिन्दु साधन कर होता है। वर्तमान सृष्टयादि से लेकर आज तक की वर्ष संख्या इस प्रकार है।

१९५५८८५०६२=सृष्टयादि सौर वर्ष संख्या।
२३४७०६२०७४४=सृष्टयादि से १३ अप्रैल १९६१ तक सौर मास।
७२१३८४७४१= ,, ,, अधिक मास की संख्या।
७२५७६०१६४५६७= ,, ,, चन्द्र तिथि संख्या।
–११३५६०१८९८३= ,, ,, क्षय दिनों की संख्या।
=७१४४०४१४५५८४ सृष्टयादि से अब तक का दिन संख्या अर्थात् यह दिन संख्या सृष्टयादि से १३ अप्रैल १९६१ तक १९५५८८५०६२ सौर वर्ष की है। शायद भूगर्भ शास्त्री भी वर्तमान पृथ्वी की २००० millions of years अर्थात् २०००००००० (२ अरब) वर्ष मानते हैं। हमारी भी १ अरब ९५ करोड़ ५८ लाख पचासी हजार बासठ वर्ष सृष्टयादि से आज तक पृथ्वी की आयु हुई। इसमें सृजन काल जोड़ने से १ अरब ९८ करोड़ के लगभग गणित आता है।

४ अरब ३२ करोड़ वर्षों के माप से ब्रह्मा की आयु जब १०० वर्ष होगी तो उस समय महाप्रलय होता है अर्थात् सब ग्रह एक बिन्दु पर आ जाने से स्थान संकोच की स्थिति के कारण समग्र सृष्टि का अन्त होगा। उस समय समस्त लोकप्रभा, ब्रह्म शरीर के केन्द्र बिन्दु में प्रविष्ट हो जाने के कारण रात्रि रूप में परिवर्तित हो जाती है और उसमें सब शक्तियों का पृथक् २ सृजन होगा।

ब्रह्म (शक्ति केन्द्र) ब्रह्माण्ड में है। पृथ्वी का पृथ्वी, जल का जल, तेज का तेज, (विद्युत) वायु का वायु, आकाश का आकाश में तथा अहंकार आदि अपने २ तत्वों में समाविष्ट हो जाने के कारण विलीनीकरण होता है। सृष्टि निर्माण काल में पृथ्वी का जल में, जल का तेज में (विद्युत) तेज का वायु में, वायु का आकाश में और आकाश का अहंकार तथा अहंकार का महात्तत्व, महात्तत्व का प्रकृति में मिश्रण होता है। सिसृक्षु ब्रह्म प्रकृति पुरुष के क्षोभ से प्रकृति से महात्तत्व, महात्तत्व से अहंकार, अहंकार से आकाश, आकाश से वायु तथा वायु से तेज एवं तेज से जल, जल से पृथ्वी पुनः सृष्टि होता है। निःसंदेह सृष्टि में या उस प्रकाश की प्राप्ति में चार अरब बत्तीस करोड़ वर्ष लगेंगे।

भारतीय ज्यौतिष सिद्धान्त गणित की विशद रूप से वर्णित सृष्टि विषयक प्रक्रिया अवश्य महत्व पूर्ण एवं गर्वपूर्ण है। सिद्धान्त के आधार पर हम समस्त ग्रह नक्षत्रों की सूक्ष्मातिसूक्ष्म गति तथा अन्य विकासात्मक परिज्ञान सहज रूप से करते हैं।

प्राचीन गणित का अद्भुत कौशल भारतीयों का सम्मान है जो विदेशों में भी मान्य है। भारतीय सरकार का कर्तव्य है कि उसके अन्वेषण में सहायता कर विकासोन्मुख की प्रेरणा प्रदान कर अभ्युदय के रूप में परिवर्तित कराये।

THE SEARCH

(A translation of Pandit Ram Naresh Tripathi's Hindi Poem 'Anveshan' by A. G. Shirreff and Sir Harry Lindsay.)

(1)

I sought Thee where the sunlit mead
Or shady grove the heart beguile,
But Thou wast seeking me the while
In humble homes of toil and need.

(2)

The sighs of those who suffer wrong
Became Thy voice and called to me,
In vain, for I was calling Thee
With sound of lutany and song.

(3)

Long, long, I watched for Thee in vain
Where flower-beds graced a garden fair ;
As long didst Thou await me where
Thy watch was kept by beds of pain.

(4)

Thou wast the tear that in the eye
Of uncomplaining misery
Trembled and fell, unmarked by me,
So bound by Beauty's spell as I.

(5)

With dulcet tones of wind and wood
I tried to woo Thee, but Thy mind
Was bent to woo debased mankind
From enmity to brotherhood.

(6)

When this gay world's kaleidoscope
Blotted Thine image from my heart,
Thy skilful touch, Thy magic art
Turned dust to gold, despair to hope.

(7)

How could I, gazing heav'nward, bend
To search the dust beneath Thy feet,
Where Thou hadst thrown Thyself, to meet
The fallen and helpless as a friend?

(8)

Time and again Thou soughtest me
For glad communion, face to face.
I offered wordy commonplace,
But deeds, not words, delighted Thee.

(9)

I sought to match Thy fame with gold
But ancient heroes, staunch in word
And deed, scorned wealth and served the Lord
Of them another tale is told.

(10)

I climbed ambition's steep ascent,
Hoping to find Thee there, but no
In humble homes, far, far below,
Serving mankind Thy life was spent.

(11)

A mighty monarch I addressed
Seeking to know where Thou dost live;
Thy life's in paladins who give
Thier uttermost at loves's behest.

(12)

Our wealthy tyrants had their day;
They had their day and seased to be.
What were their pageantries to Thee
But shadows of a shadow-play?

(13)

Prophet and saint have learnt from Thee
The secret of Thy dwelling-place;
But Thou hast turned away Thy face
From hypocritic Pharisee.

(14)

I thought to find Thy majesty
In Sohrab's herculean frame ;
And Lo ! Thy revelation came
In Gandhi's lean anatomy.

(15)

So wide our ways have lain apart,
How can I hope to come to Thee ?
Help of the helpless, look on me,
And, pitying, take me to Thy heart.

(16)

Grace of a sunbeam as it flies,
Beauty of blossom, breath of breeze,
Vastness of heav'ns expanse, all these
Thy wondrous attributes comprise.

(17)

Who seeks aright, Thy presence finds
In Muslim faith, In Christain love,
In Hindu wisdom, and, above
All else, in truth in all true minds.

(18)

Lord, grant me insight, I beseech ;
Implant Thine image in mine eyes,
Thrill my heart's thoughts to ecstasies,
And give them utterance in speech.

(19)

"Why sorrow, suffering and distress,
Harsh headlines on the scroll of fame ?"
"My power alone", Thine answer came,
"Gives strength to bear the pain and stress".

(20)

So let that power suffice for me ;
In sorrow, let me not despair,
In joy, let each glad heart-beat share
Unfading memories of Thee.

अन्वेषण*

श्री रामनरेश त्रिपाठी

(१)

मैं ढूंढ़ता तुझे था जब कुञ्ज और वन में।
तू खोजता मुझे था तब दीन के वतन में॥

(२)

तू आह बन किसी की मुझको पुकारता था।
मैं था तुझे बुलाता संगीत में भजन में॥

(३)

मेरे लिए खड़ा था दुखियों के द्वार पर तू।
मैं बाट जोहता था तेरी किसी चमन में॥

(४)

बनकर किसी के आँसू मेरे लिए बहा तू।
आखें लगी थी मेरी तब यार के वदन में॥

(५)

बाजे बजा बजा के मैं था तुझे रिझाता।
तब तू लगा हुआ था पतितों के संगठन में॥

(६)

मैं था विरक्त तुझसे जग की अनित्यता पर।
उत्थान भर रहा था तब तू किसी पतन में॥

(७)

बेबस गिरे हुओं के तू बीच में खड़ा था।
मैं स्वर्ग देखता था झुकता कहाँ चरण में॥

(८)

तू ने दिये अनेको अवसर न मिल सका मैं।
तू कर्म में मगन था मैं व्यस्त था कथन में॥

(९)

हरिचंद और ध्रुव ने कुछ और ही बताया।
मैं तो समझ रहा था तेरा प्रताप धन में॥

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* इसी कविता का अँग्रेजी अनुवाद ए. जी. शिरेफ द्वारा पहले दिया गया है—सम्पादक

(१०)

मैं सोचता मुझे था रावन की लालसा में।
पर था दधीचि के तू परमार्थ-रूप तन में॥

(११)

तेरा पता सिकंदर को मैं समझ रहा था।
पर तू बसा हुआ था फरहाद कोहकन में॥

(१२)

क्रीसस की हाय में था करता विनोद तू ही।
तू अन्त में हसा था महमूद के रुदन में॥

(१३)

प्रहलाद जानता था तेरा सही ठिकाना।
तू ही मचल रहा था मंसूर की रटन में॥

(१४)

आखिर चमक पड़ा तू गांधी की हड्डियों में।
मैं था तुझे समझता सुहराव पीलतन में॥

(१५)

कैसे तुझे मिलूंगा जब भेद इस क़दर है।
हैरान होके भगवन आया हूँ मैं सरन में॥

(१६)

तू रूप है किरन में, सौन्दर्य है सुमन में।
तू प्राण है पवन में, विस्तार है गगन में॥

(१७)

तू ज्ञान हिन्दुओं में, ईमान मुसलिमों में।
तू प्रेम क्रिश्चयन में है सत्य तू सुजन में॥

(१८)

हे दीनबन्धु ऐसी प्रतिभा प्रदान कर तू।
देखूं तुझे दृगों में मन में तथा बचन में॥

(१९)

कठिनाइयों दुःखों का इतिहास ही सुयश है।
मुझको समर्थ कर तू बस कष्ट के सहन में॥

(२०)

दुःख में न हार मानूँ सुख में तुझे न भूलूँ।
ऐसा प्रभाव भर दे मेरे अधीर मन में॥

THE ONLY PEER OF THE SAGE OF SABARMATI

C. Y. CHINTAMANI

I regret very much that grave and prolonged illness should have prevented me from attempting an adequate appreciation of Pandit Madan Mohan Malaviya as I was kindly desired to do and as I fully intended to do, almost as a matter of duty. I am still unable to undertake the task if I am to do anything like full justice to it. I would be most sorry if in this commemoration Volume there is not at least a brief and feeble expression of my immense respect and admiration for and gratitude to one who has commanded my reverence and affection ever since I was honoured with his friendship nearly thirty years ago.

Pandit Madan Mohan Malaviya is nothing but heart from head to foot. Full of the milk of human kindness; charitable indeed certainly, but, what is less common, in judgment; unselfish to a fault; tenacious in adhering to his opinions, sometimes to the point of obstinacy, at the same time with a broad toleration for the opinions and feelings of others; with any amount of respect for age and seniority; with no end of pride in his religion and country; and very sanguine about the future of his race; loyal to friends and forgiving to opponents; Pandit Madan Mohan Malaviya is a model of a Hindu and a Brahmana.

When the project of the Hindu University was mooted, it was thought by many that it will continue to live only in the fertile mind of Panditji, as a result of his incurable optimism and tireless labour, it is now a grand and noble fact. I know no other man in the whole country and it is my good fortune to know many of India's best men-who could or would have succeeded in translating 'holy madness' into accomplished fact, as Pandit Madan Mohan Malaviya has done. And what greater monument could man wish for than the Hindu University?

Today among India's public men Pandit Madan Mohan Malaviya's place is second only to that of Mahatma Gandhi, and he is the only man fit to be bracketed with the sage of Sabarmati. Differences of opinion, of outlook, of method, there will be as there have been between the best of men. But who that knows Pandit Madan Mohan Malaviya and his record of continuous and ceaseless public activities of nearly half a century, ennobled by devotion and sanctified by sacrifice, will have the hardihood to withhold from this selfless man and stainless gentleman the high praise that he has richly earned by his *Guna* and *Karma*? The greatest man of the United Provinces for at least a century, it is singular good fortune that Pandit Madan Mohan Malaviya, who has rarely enjoyed robust health, is still hale and hearty and at work in the service of the Motherlands at the age of three score years and ten. India needs her beloved and devoted son for yet many a long year, and on his seventy-first birthday it will be the prayer of millions of his brothers and sisters that God : Almighty mayl eave him with us in health and stength for many more years.

Malaviyaji ki jai. Vande mataram

VICE-CHANCELLORS WHOM I HAVE KNOWN.
III—PANDIT GOVIND MALVIYA

Dr. A. B. MISRA

When taking leave of the Banaras Hindu University, Dr. Amarnath Jha, a shrewd student of human affairs, said, in a farewell function held in his honour, that "the Vice-Chancellor of the Hindu University is invested with the strength of a giant, but, he hoped, that that strength will seldom be used". Perhaps he could read the writings on the wall. The advice was, however, lost upon his successor.

The so-called milli-volt power passed, for good or evil, into the hands of one who by birth and by design was destined to be the Vice-Chancellor of this University one day. Only that day came a bit too soon.

Pandit Govind Malviya bore a great name. He relied too much upon his birth and ignored the laws of genetics.

Various estimates have been made of this stocky scion of a great family. Some maintain that he ought not to have shod his father's shoes ; other swear that the mantle that he wore was too big for him. I will only say that his arrival in the University was ill-timed and that he was ill-prepared for the great office that he tried to hold. Had he bided his time for a decade more and apprenticed as a lower division officer, under one or two Vice-Chancellors, the course of history of the Hindu University might have been different. During such apprenticeship he would have become groomed for the high office of the Vice-Chancellor and nobody would have disputed his title to it, if he had been properly processed for it.

The entry of young Malviya into the University, with the following of a mixed sort, sent a shiver down the spine of the university.

Perhaps following the tradition of Emperor Jamshed, who kept the lions and the lizards together, he attempted to maintain a court of wolves and lambs who could not keep company together for long. His fall was as rapid as his rise to power in this university. What was said about Cromwell applies equally well to him :

"Extreme in all things,
Had'st (he) been betwixt,
(His) throne would ever been (his)
Or never been".

रवि बाबू के पत्र : महामना के नाम

संगृहीत—श्री राय कृष्णदास

महामना जी देश की प्रत्येक समस्या के प्रति कितने जागरूक थे और बड़े से बड़े व्यक्तित्व भी इस सम्बन्ध में उनके कितने मुखापेक्षी थे इसका पता उन पत्रों से चलता है जो रवि बाबू ने समय-समय पर उन्हें लिखे थे। महाकवि के लिखे ऐसे कुछ पत्र दे रहा हूँ। इनमें जिन समस्याओं को लेकर उन्होंने मालवीय जी से अपील की है वे भिन्न-भिन्न हैं फिर भी उनमें एक बात में एकत्व है कि रवि बाबू उन समस्याओं का हल मालवीय जी के द्वारा ही सम्भव समझते थे।

इनमें से पहले पत्र का विषय है :—

VISVA BHARATI
SANTINIKETAN, BENGAL
November 15, 1932.

Dear Malaviyaji,

I have just received a letter from Mahatmaji, a copy of which I enclose for your private inspection. While I believe that in view of what our countrymen have already done and continue to do now they should not be subjected to the extreme suffering for the sins of reactionary groups who hold the ground here and there ; we on our side must leave no stone unturned to avert the terrible crisis of Mahatmaji beginning another fast unto death. It is a great relief to me and to our countrymen to know that you personally intend to visit the authorities of the Guruvayyur temple. Your influence, I confidently hope, will be able to win over the Zamorin and get the trustees to effect the necessary changes in the law which seemingly stands in the way of reform. India certainly cannot let Mahatmaji or Kelappan resume their fast which will be taking too much risk.

I had hesitated as to the message I could send to the Unity Conference till it was too late. I feel that your great efforts have achieved a very large measure of success, and has had a perceptibly wholesome effect on our communities. We are deeply grateful for the lead you have given to our country in its present crisis.

With prayers for your health and the success of....efforts,

Sincerely yours,
Sd/- RABINDRANATH TAGORE

VISVA BHARATI
SANTINIKETAN, BENGAL
November 15, 1932.

Dear Mahatmaji,

I can realize the sanctity of the promise given by you to Kelappan, and certainly nobody from outside can presume to criticize any action that you may decide upon guided by your own direct revelations of truth. What I fear is that following so close upon the tremendous impact made on our consciousness by the recent fast a repetition of it may psychologically be too much for us properly to evaluate and effectively to utilise for the uplift of humanity. The mighty liberating forces set in motion by your fast still continue to operate and spread from village to village, removing age-long iniquities, transforming the harshness of the callously superstitions to a new feeling of sympathy for the distressed. Were I convinced that the movement has suffered any abatement or in any way shows signs of lacunae, I would welcome even the highest sacrifice which humanity today is capable of making, the sacrifice of your life in Penance for our sins. But all my experiences of the activities of the villages around us here, as well as of other localities, convince me that the movement generated by your fast continue to gain in strength and conquer formidable obstacles. The testimony of my friends from all parts of India confirm this truth. It may be that there are reactionary elements but it seems.....................................them time— the pressure of a growing public .... Even as to the Guruvayyur temple .... side of reform. I pray .... and constitutionally remove the legal barriers which seem to stand in the way of reform. Should we take too seriously the activities of some isolated groups of individuals and subject millions of our countrymen to the extremest form of suffering while they themselves are unquestionably on the side of truth? The influence which is at work may have a check if anything happens to you. Should we risk that possibility now that we have won? These are

the thoughts which naturally rise in my mind and I was thinking of putting them before Mahadev when your letter arrived. I shall continue to follow events with my thoughts and prayers and fervently hope that those who now stand in the way of truth will be converted to it.

With reverent love,

Yours,

Sd/- Rabindranath Tagore

× × ×

Yeravda Central Prison,
10-11-32.

Dear Gurudev,

You must have seen the statements I have circulated to the Press. I want your blessing if I can have them for this further effort. I do not know whether you feel that this effort is, if possible, purer than before. The last fast had a political tinge about it and superficial critics were able to say that it was aimed at the British Government. This time if the ordeal has to come, it will not be possible to give any political colour to it. You will of course recall that the last fast was broken on the clearest possible notice that I might have to resume if there was any breach of faith by the so-called Caste Hindus. The prospective fast about Guruvayyur Temple is absolutely a point of honour. It is being made by the orthodox section the centre of attack and is being given an all India significance. I rather like it. But it makes it all the more necessary for the liberalising influences to be collected together and set in motion in order to overthrow the monster of untouchability. I want your wholehearted co-operation if you feel as I do.

I hope you are keeping well.

With deep love,

Yours,

Sd/- M. K. Gandhi.

दूसरे पत्र में रवि बाबू ने एक अन्य विषय उठाया है :—

SANTINIKETAN
18th August, 1934.

My Dear Paṇdit Ji,

I address this to Mahomedans as well as Hindus with the most sincere desire for the good of all sections of community. I urge that Hindus and Mahomedans should sit together dispassionately to consider the Communal Award and its implications and arrive at an agreed solution of the communal problem. It is needless to point out that self-government cannot be based on communal division and separate electorates, no responsible system of government can be possible without mutual understanding of our communities and united representation at the legislatures. We must concentrate all our forces to evolve better understanding and co-operation between different sections of our people and thus lay a solid foundation for the social and political reconstruction of our motherland. I deprecate all expressions of angry feelings and most strongly appeal to Hindus and Mahomedans to avoid saying and doing anything that may increase the communal tension and further postpone an understanding between our communities without which there can be no peaceful progress in our country.

Cordially Yours,
Sd/- RABINDRANATH TAGORE.

कहने की आवश्यकता नहीं कि महामना ने इन विषयों के सम्बन्ध में समुचित प्रयत्न किया। प्रसंगवश यहाँ यह बात भी ध्यान देने की है कि रवि बाबू भी केवल कवि एवं चित्रक ही नहीं थे। वे देश की प्रत्येक समस्या के प्रति सक्रियरूप से सोचते थे। इसी से उन्होंने महामना जी को उस समय के ज्वलंत समस्याओं पर ऐसे पत्र लिखे।

———

प्रश्न–चिह्न

पृथ्वीकुमार

प्रश्न चिह्न ऐ, महा जटिलतम,
अहे ज्ञान के व्याकुल स्रोत !
लहरें बन कर ढूँढा करते
उर–नीरधि में उत्तर–पोत ; [१]

प्रखर अग्नि ! तुमको उत्तर के
जल से सींच सका है कौन ?
अंतरंग आधार बने हो
मुख्य तुम्हीं, उत्तर है गौण ; [२]

वैरागी निर्लिप्त आदि की
बची हुई केवल इच्छा—
तपस्वियों को सदा सालती
रहती तव उत्सुक पृच्छा ; [३]

तुम्हीं ब्रह्म की अगम कल्पना,
या समष्टि की व्यष्टि समुद्र !
हे बंकिम, ताण्डव का टेढा
लास्य लिए हे शाश्वत रुद्र ! [४]

चिर कौतूहल, उत्सुकतापति,
जिज्ञासा के सजग प्रतीक !
अये शान्ति के शत्रु, साथ में
चिन्ताओं की लिए अनीक , [५]

अहे कुण्डलित, अथवा तजते
गरलित फूत्कारें तुम झूम ,
अंतर्दाह भयानक, अविरत
करते रहते प्रकटित धूम ! [६]

नीचा सिर कर सोच रहे हो
तुम अनन्त के लघु अनुमान !
मिथ्या और सत्य की निश्चित
करते रहते हो पहचान , [७]

आश्वासन दे सदा सत्य को
तर्कों का करते आह्वान।
और मांगते हो विवेक से
खरे और स्थिर पुष्ट प्रमाण! [८]

क्यों, क्या, कैसे, कौन, कहाँ से—
भिन्न-भिन्न ये तव दृढ स्तंभ।
ढक लेता है समाधान को
केवल एक 'नहीं' का दंभ, [९]

कौन दे रहा, भला कहाँ से
कैसे इस जगती को स्फूर्ति?
सर्वनियंता अस्तिमदुत्तम
की है कैसी सुन्दर मूर्ति? [१०]

तुम विशेष मुद्रा से अपनी
अविदित का करते संकेत,
जग की आँखों में नित नर्तित,
माया के हो सघन निकेत! [११]

रहते सजग निरंतर, भू पर
अरे अनिश्चय के अवतार!
किन्तु जहाँ न निवास तुम्हारा
वहाँ नहीं कुछ अटल स-सार। [१२]

विप्रलंभ में शोच हृदय के
शंका की चिर माया में।
विस्मय के तुम चित्र अनोखे
विभ्रमता की छाया में! [१३]

बन पर्वत तुम स्वयं घूम कर
करते हृत्सागर मंथन,
निष्ठुर सर्प सदृश बन करके
असुरों को करते दंशन, [१४]

कुछ विचार-लहरों की मुंदित
खुल पड़ती हैं काराएँ,
और निकलती हैं मंथन के
फलस्वरूप विष धाराएँ, [१५]

विष के असत् भाव में जब तुम
कर लेते हो उसका पान,
होती है फिर अमृत प्राप्ति भी
उत्तर के घट में अम्लान। [१६]

बन कर पथिक, सतत चलते ही,
चिंता-पथ के पारंगत
उत्तर-गिरि पर चढ़ जाते जो,
लखते तुच्छ विभव अवनत; [१७]

चहुँ दिशि संभावना तुम्हारे
सतत भ्रमित हो रही विचित्र!
किस रहस्य के खोजी हो तुम
अथवा कहो स्वयं ही मित्र! [१८]

किसलय से, जिस पर जल कण पड़
ढुलकें जैसे हीन विषय!
ऐ अनादि, गंभीर, आशमय!
चिदानंत हे चिर अव्यय! [१९]

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ELECTRICITY IN PLANT-SCIENCE

U. S. GUPTA,

PART I

Electric response has been found by Munk, Burdon-Sanderson, and others to occur in sensitive plants. In this connection, Kunkel observed the electric disturbance to be due to movement of water through the tissue. But with the advance of knowledge, now we know that this explanation is inadequate. For in that case we should expect a definite stimulation to be under all conditions followed by a definite electric response, whose intensity and sign should remain invariable. But the response is at its maximum at an optimum temperature, a rise of a few degrees produces a profound depression, the response disappears at the maximum and minimum temperatures, and is revived when brought back to the optimum. Anaesthetics and poisons abolish the response while the stimulants exalt it. Again, the response undergoes an actual reversal when the tissue is stale. All these facts show that mere movement of water could not be the effective cause of plant-response.

Haake pointed out that electrical differences between different points were also to be found, even in submerged plants, like *Vallisneria* and *Nitella*, in which there could not possibly be any differences of absorptiveness. This difference, therefore, he suggested, must be ascribed to some vital process, inasmuch as the potential difference is seen to undergo a charge whenever the respiratory process is interfered with—say—by the substitution of hydrogen for oxygen.

Munk attempted to explain the complicated electrical effects which he observed in *Dionaea* by assuming the existence of two different kinds of electro-motive elements, affected in opposite ways; the maximum charges being initiated in one set earlier than in the other. In this way, he thought, it might

be possible to explain the occurrence of positive and negative variations, holding that the upper parenchymatous layer of the leaf, and the upper midrib, went through the negative, and the under layers and the under midrib through the positive charge.

In 1912 Dudgeon put forward a theory that under the influence of electrical discharge, the ingredients in the soil necessary to plant growth are rendered more soluble and more easy of assimilation ; that the sap is enabled to flow more vigorously and the formation of starch and sugar is increased and respiration, absorption and evaporation are accelerated and by increased chemical activity in the plants, its whole fabric is improved.

According to current theories, living matter is maintained in a state of equilibrium by the two opposed chemical processes of assimilation and dissimilation. It is supposed that stimulus causes a down grade or dissimilatory change, which is again compensated during recovery by the building up or assimilative charge. In case of uniform responses, again, these two processes are regarded as balancing one another. On this theory, when the down change is greater of the two, the potential energy of the system falls below par ; for the building-up process cannot then sufficiently repair the chemical depreciation caused by it. Hence, diminution of response, or fatigue occurs which is supposed to be further accentuated by the accumulation of deleterious fatigue-stuffs. The disappearance of fatigue after a period of rest is explained by the renovating action of the solute-supply, which is also regarded as the means of carrying away the fatigue-stuffs.

Stimulus causes molecular derangement in a tissue. The conditions of molecular upset and return to the state of equilibrium correspond to the state of excitation and recovery from the state. The molecular disturbance is attended by various physico-chemical changes in the properties of the substance, among the most important of which in a living tissue may be mentioned (1) contraction of the excited cell, and expulsion

of water ; (2) electromotive variation ; and (3) conductivity variation.

By means of electrical response it is found that, not sensitive plants alone, but every plant and every organ of the plant is excitable. Positive turgidity-variation, by whatever means produced, causes positive mechanical response or in the case of *Mimosa*, erection of the leaf and galvanometric positivity. There is a minimal intensity of stimulus necessary to initiate response. A stimulus, singly ineffective, becomes effective on repetition. Its increasing intensity produces increasing response, which, however, tends to approach a limit. The effects of rapidly succeeding stimuli in plant-tissues becomes fused, individual effects being then indistinguishable. A maximum contractile effect is then produced depending on the intensity of the stimulus.

It, by causing molecular derangement, brings about mechanical response ; and by molecular transmission of disturbance from point to point, the excitation is conducted to a distance. Excitatory mechanical response and conduction of excitation are different expressions of the effect of stimulus. After a period of rest from the action of stimulus, there is a restoration of molecular equilibrium. The protoplasmic properties of excitability and conductivity are then completely restored. Under such normal conditions responses are uniform.

When sufficient time is not allowed, there is a residual molecular strain. The conductivity and excitability of an organ are thus diminished, and the responses undergo diminution, in consequence of cumulative residual strain. Fatigue is greater in a motile than in a conducting organ. Motile excitability disappears earlier than conductivity.

The fibro-vascular elements are the best channels for conduction of stimulus : in them, the transmission lengthwise is greater than crosswise. Indifferent parenchymatous tissue has little or no power of conducting stimulus. The direct effect of stimulus is not transmitted by means of hydrostatic dis-

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turbance, but by a cell to cell propagation of excitation. This transmission of excitation from cell to cell is attended by a cell-to-cell contraction.

The epidermal layer of living tissues is less excitable than those which are deeper seated. It is to be noticed that light acts from out side, its excitatory influence affecting the outer most tissue first, and only be gradual percolation passing to the subjecent. Various circumstances, such as age and season, have an important effect in varying the excitatory reaction of a tissue. In colocasia, young roots give negative, whereas older roots give positive responses.

This movement of water is not brought about by any hydro-mechanical action, but is the direct effect of the contractile wave due to excitation. The hydrostatic disturbance, when present, is transmitted with very great velocity, and its effect is seen in the abnormal preliminary response of erection, exhibited, for example, by the leaflets of *Biophytum*.

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6. Kunkel (1878-1881) Cf. Haake, "On stream currents, and on electrical endosmosis". p. 457.
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Part II

The exoplasm is an enveloping insulating membrane or capsule, designed principally to conserve the energy of the cell, and the cell itself is a species of Leyden jar, capable to some extent of self charge. The nucleus and nucleolus are always centrally situated (a fact in itself suggestive of similarily electrified bodies) and the centrome—(the attraction sphere of physiology) is *single*.

In normal conditions of weather, air is the positive and earth, the negative terminal of Nature's electrical system. Every thing growing in the earth, is negatively charged through the roots, stems and venation, and positively by the air through the aerolae of the leaves, so that in the roots, stems and venation the tree or plants has its negative and in the aerolae its positive terminals. There is, in fact, an ordinary electrical circuit, i.e., air to earth, and earth, through the plant, to air.

Electro-chemical treatment of seeds is the easiest approach to the study on effects of electricity in plant-science, and *Wulfryn* process is by far the most used one. It consists in placing the seed to be treated in a bath containing a suitable metallic salt such as $CaCl_2$ or NaCl (2.5 to 5% w/v) and weakly electrifying the same for a length of time appropriate to the seed under treatment. The solution is then run off, and the seed taken out and dried. The object of the salt is not only to decrease the resistance, or, in other words, to increase the conductivity of the seed coat, but to maintain that conductivity during the period of germination. The effect of electrical stimulus continues even after disconnection of current, and such stimulus tends to advance the development of the embryo plumule, radicle and cotyledons. In other words, the effect of the process is to mature the seed. Calcium and sodium in correct proportions are, moreover, plant foods and assist in the after stimulation of food production.

Kumar and Rajbhandari (1953) have showed that the electrical treatment of wheat seeds results in increased yield to the extent of about 14% by sowing the treated seeds. Kumar

and Pandeya in a later year (1955) have similarily found an increased yield of about 9% in wheat resulting from such treated seeds.

The fundamental principle governing the germination of a seed is this : the seed substance must receive a continuous charge of electricity ; this charge must be induced or the seed would rot, and no such charge can be imparted until the seed becomes in effect a Leyden-jar. Water, air and warmth are of course necessary, but these also are in electrical connection ; water to give conductivity and aid in the formation of protoplasm, air to complete the circuit and warmth to facilitate conduction.

Puncture of the inner membrane of the acorn—or indeed of any seed—would prevent germination by reason of interference with its electrical structure. Generally speaking, this could not be otherwise than fatal because with the perforation of the insulating membrane the electrostatic capacity of the seed would be lost. We have duely noted the fact that the seed requires warmth as well as moisture and oxygen to enable it to germinate. In cold weather not only is the resistance of the electrolytes in the soil increased so that less current is present in the environment of the seed, but the resistane of the liquid content of the seed substance is also enormously increased, two conditions which militate against the full measure of electrification upon which germination is dependent (Baines, 1921).

When plants are grown in pots they are cut off from the negative earth current and the moist soil in the pot, takes its charge from the positive air, and the plant reverses its polarity, becoming positive where an earth-grown plant is negative and *vice versa*. The effect of this is to stimulate upward growth, and were the electromotive force higher there would be very little root production. Such plants are not, in fact, grown naturally and would be far better if the soil in the pots could be connected, by means of a metallic conductor, with the earth, other things, of course, being equal.

There is, I need hardly say, a great deal of difference between seed electrification and electrification of the soil. When the so-called electrified seed is sown, it is not electrified, but is just an ordinary seed in a state of maturity, and with germination and the consequent rupture of the inner membrane it ceases to possess electrostatic capacity, becomes a seedling and takes its charge direct from the earth, first through the lower end of the radicle and later through the filaments which the radicle throws out. But when electricity is applied to the soil there is continuous electrification of the seed and of the seedling also and the elecromotive force and sign of current incidental to that added stimulus should be studied and their effect observed.

It has often been stated that an electric discharge increases the rate of growth of plants either by direct action on the plant, or by indirect action in the soil. As far back as 1783 Abbé Bertholon constructed his electro-vegetometer, a kind of lightening conductor that collected atmospheric electricity and then discharged it from a series of points over the plant. The view that atmospheric electricity is an important factor in crop growth has always found supporters in France. Grandeau stated that plants protected from atmospheric electricity by a wire case made less growth than control plants out side. Instead of relying on atmospheric electricity Lemstrom generated electricity on a large scale and discharged it from a series of points affixed on wires over the plant. This method has been used at Bitton, near Bristol, and studies on the electrical side by Sir Oliver Lodge, on the botanical side by J. H. Priestley, and on the practical side by J. E. Newman, were made. The significance of electric discharge on field crops was pointed out by Jorgensen and Priestley (1914) and Jorgensen and Stiles (1917).

The average electromotive force of any growing in the earth, from the smallest plant to the largest tree, from the smallest apple to the largest vegetable marrow, is under 0.1 volt, and it seems as unreasonable and unscientific to make too

wide a departure from the voltage, as it would be to largely exceed the maximum normal temperature.

Reversal of the natural sign, i.e., the downward driving force invariably leads to enforced upward growth and diminished root production. In this way plants have been grown from mustard seed, 4′ high but there was very little root, and very few seeds. To assist germination, however, and to help the plant to vigorous life it is desirable to oxygenate the soil, so that when the rupture of the seed coat takes place and the radicle pushes its way downwards, a supply of oxygen may be assured to the seedling. Now carbon has great affinity for oxygen, will readily absorb it and give it out again under the pressure of water. This, no doubt, is the reason why, taught by experience, gardeners place pieces of charcoal in the soil of the pot.

Now, while water is essential as an electrolyte it is not an electrolyte of low resistance and it is to be feared that the vegetation would fare badly if soil conductivity depended on moisture alone, for current in sufficient quantity is required to be constantly supplied to the roots. In much the same way that the path lightening from cloud to earth is governed by the distribution of electrolytes in the air so the direction or directions taken by earth currents must be subject to the distribution of electrolytes in the soil and their quantity be in the inverse ratio to the resistance of the path or paths. It follows, therefore, that if every portion of the soil—or those depths which are reached by the roots of plants—is to receive the same current supply it must not only have exactly the same conductivity but must not be shut off by fault, or break of continuity, such as those described by Russell (1950).

In warm damp weather conductivity is at its maximum. Cold increases resistance especially of liquid and semi-liquid conductors enormously, and consequently lowers the quantity of current supply, not only to the roots but in its circulation through the vegetable organism.

Now copious water supply counterfeits electrical stimulus by reducing soil resistance to the minimum permitted by temperature and encourages the plants to continued growth. It is mentioned that under electrical stimulus mustard plants were 4′ high, but the seeds were few in number and very late. Given a suitable electrolyte in and same measure of electrification of the soil a plant would probably thrive upon a mere fraction of the water ordinarily required.

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Part III

The idea of using electricity to stimulate plant life and increase crop production is a most alluring one and has engaged the attention of several persons, who have devised several methods of applying it in practice. Very encouraging results are reported to have been obtained, but somehow they have

failed to carry conviction, and the attitude of the scientific world and of the practical agriculturists is one of scepticism. The object of electro-cultural methods is to force better flowers and fruits out of season, well ahead of it or after its end, so that higher prices may be fetched. Another inducement is to obtain better variety of fruits. Further, electro-cultured fruits, are invariably better in taste, finer in appearance, more resistant to diseases than those obtained in the ordinary or garden ways.

In 1783, Berthelon experimented with agricultural crops and recommended its use as a remedy against fungal diseases and insect pests. Since then, off and on experiments have been carried out in Europe, United States, Canada, Australia, and New Zealand, and it is claimed that the results have established beyond doubt the beneficial effect of the application of electric stimulants to plants or seeds. As regards the methods of application of the electric current, they fall into the following classes—

(1) Illumination by electric light. (White light, X-ray and Ultra-violet ray)
(2) The conduction of atmospheric—electricity from elevated conductors to the soil.
(3) Burying plates of copper and zinc in the soil, and using the soil as an electrolyte.
(4) Passing a current through the soil from external sources.
(5) Silent discharge from antennae or overhead network of wires.
(6) Passage of the high tension electric spark through the tissue. (tickling)
(7) Planting in a radio-magnetic bed.
(8) Electro-chemical treatment of seeds.

Experiments have been made (Nehru, 1931, 1932, 1935) with cereals, pulses, oil seeds, vegetables, fruits, flowers, industrial plants, on diseases and pests and on varigated plants. The results have proved fairly encouraging and satisfactory. Every seed, plant and soil has responded to treatment. The

effect of energising seed or plant or soil or any two or all, has been observed in—

(A) Increase in height of plant.
(B) Hastening maturity.
(C) Increase in quality of yield.
(D) Increase in quantity of yield.
(E) Increased resistivity.
(F) Longevity.

Cereals fall under the above heads, especially A, B, C and D; pulses fall under B; oil seeds especially under A, B and C; fruits under A and B, and flowers under A, B, C, D, E and F. A striking example is furnished by *Zinnia* energised which flourished and bore blossoms while the control plant died out. Marigolds and chrysanthemums energised have given more numerous, bigger and brighter flowers. The most striking instance of increased resistivity under E is furnished by wheat which was sown unseasonably in August.

Energised mango seedlings have grown and put forth new leaves unseasonably in winter, while the control ones have kept dormant. Graft of mango bud, energised, has grown very fast, while the control one died out. Energised potatoes, sown unseasonably have grown rapidly, while the unenergised control took a considerable time even to germinate. Energised sugarcanes, strawberries, gooseberries and oranges have all shown remarkable improvement and superiority over the control plants.

Blackman, Legg and Gregory (1923) exposed the coleoptile of the barley seedlings to an electric discharge; the *after effect* of which was greater than the *direct effect*. However, when the coleoptile was negatively charged, the rate was little, if at all, above the normal. The most extensive field work in this regard, however, was performed by Blackman (1924) in experiments with spring sown oats and barley, winter wheat and clover. Blackman and Legg (1924), and Shibusawa and Shibata (1927) found increased yield of cereals with an electric current of very low intensity. Singh (1932) noted an increase in root growth as great as 400% but no visible effect on the

growth of tops. Musso (1933) found that oats headed earlier, formed a greater number of stalks and yielded 20% more dry weight than the controls when a strong positive potential was applied to the soil.

Bellinazaghi (1914) considered that the effect of radio-frequency field on the resting seeds may be speeding or inhibiting the germination, according to the length of the treatment. Germination of 4-year old *Vicia faba* seeds was greatly increased and hastened. Cell division in the growing points was also stimulated. Increase in number and early initiation of lateral roots in onion following a current of 50 microamperes (IR drop 15 mv./mm.) was noticed by Berry, Gardiner and Gilmartin (1947). Both gross abnormalities like, local swelling, twisting, spiralling and doubling of roots and microscopic abnormalities like enlargement and vacuolation of cells, thinness of their walls and disorientation of the cells in the central cylinder were apparent. Further, in 1955, Scott, Aulay and Jeyes established a correlation between the electric current generated by a bean root growing in water and the rate of elongation of that root.

Franklin (1957) found that vegetative growth of *Pelargoniums*, *Rhododendrons*, beans and holly trees was stimulated by electric fields. This was greatest in the positive fields, next greatest in the negative fields, less for the controls and least in grounded cages surrounding the plants. There was evidence that the stronger the field the greater the growth. Working with cucumber seeds, Izakov, Loginova and Basov (1958) found better germination, stimulated seedling development and increased yield of the first picking by 50% and the total yield by some 20%. High tension electric fields greatly improve the rooting of Amur vine (*Vitis amurensis*), an exposure to 4 Kv/cm. for 5 seconds proving the best (Potanina and others, 1959).

Kicigin (1955) studied the effect of atmospheric electricity on the growth and development of barley and broad bean plants shielded from atmospheric electricity by a wire mesh. Shielded plants produced longer shoots than the controls. The weight

of dry matter, however, was in both cases the same and the control plants produced more flowers and a little earlier, indicating that atmospheric electricity had a slight accelerating effect on development. Storms also have profound influence on the electric properties of a tree and the earth (Burr, 1956). He reported that during a severe storm a reverse polarity develops in the earth and is paralled by a change in the tree, though beginning somewhat sooner and taking a little longer time to develop.

One soon realises that an electric discharge *per se*, would be valueless. Value attaches, however, to its *side effects* and *after effects*: ozonization, nitrification, ionization of the air, electrification of the atmosphere, electro-aeration of the soil and subsoil etc. A preliminary treatment, for a few seconds or minutes, of plant seed, before it is sown, should have a powerful effect on its germination, maturity and life. Such effect will be wholly beneficial, provided the limits to tolerance—electrical, not physical—are exceeded during treatment. This treatment of electrification by means of strong electric sparks goes to energise, the plant roots, subsoil and soil. Whatever the nature, constitution, reaction or behaviour of the individual seed, it is powerfully energised by the passage of the high tention electric spark across it. The seeds of summer wheat have been energised and activated by spark treatment, acquire great resisting power and protection against the diseases which kill off the untreated seeds (rusts and smuts).

Plant pests and diseases have powerfully responded to electrical treatment. Aphis and white ants have been killed very easily. Plants suffering from leaf curl have been completely cured. Cereals affected by rusts and smuts have been either cured or improved (Nehru, 1932).

Internally seed borne diseases of oat (*Helminthosporium*) and barley (loose smut) have responded partially to the radio-heating of seeds (Grainger and Simpson, 1950). Tobacco root-knot nematodes have also been controlled (Daulton and Stokes, 1952 and Stokes and Martin, 1954).

Plants attacked by a pest, can be treated with electricity with two objects : (1) to fortify them in withstanding the pest by energisation and (2) to destroy the pest itself by electric treatment (Aphis in mustard, white ant and borer in sugarcane and locust pests etc.) Direct sparking of the affected part for a few minutes suffices to clear the plant of the pest altogether. It further invigorates the plant causing very powerful increase in growth and yield alike.

Use of electric bulbs has been made as light traps for catching certain phototropic pests. Larue (1948) has reported a nightly catch of 850 insects with a 150 watt bulb installed at a height of 6-7 meters. For the nonflying insects, on the other hand, Wheatley and Moczarski (1950) have used metal barriers through which a 35 volt alternating current at 1000 cycles/sec. was passed (Aphids). Disinfection of fruits, vegetables, grains, seeds and stored products has also been acheived (Thomas, 1952; Frings, 1952). Under favourable conditions of differential heating pests can be destroyed without injury to the host. Baker, Taboada and Wiant (1954) reported that an electric dose of 10000 rep. was lethal to all adult—bean weevils one week after the treatment. European plant protection organization (1953) has also reported that weevils can effectively be destroyed by the use of high frequency electric current.

Attempts have been made at Colorado Agricultural Experiment Station, in 1945-46 to control the weeds—bind weed and Russian knapweed—by use of electric current. Hodgson (1950) developed a unique device to distribute a charge of electricity into plant foliage as it is pulled over weeds. The weeds tried at Idaho were white top (*Papidium draba*), Canada thistle (*Cirsium arvense*) and field bind weed (*Convolvulus arbensis*).

Ferguson (1945) has stored the food products in high frequency, alternating electric fields. At a temperature of 130-140°F, all the four stages of insect life were killed in 10-14 seconds. Moyer and Stotz (1947) and Moyer and Holgate (1947) have blanched potatoes electrically. But the blanched samples were inferior in flavour and colour with a loss in ascorbic acid content.

Two Russian workers, Schmuck and Ilyin (1935) have found a diminution of nicotine content in a strong tobacco variety following electric treatment. Gualdi (1950) has also noticed a diminution in nicotine content, but the diminution was at the cost of combustibility and hence flavour, and that the heating of the tobacco experienced during the process leads to deterioration in quality. Ilin (1957) reported that electric fermentation of tobacco leaves, shortens the time required and losses in weight are also minimum. Totubalin (1958) has also obtained favourable results as regards the moisture content, enzyme activity, composition, flavour and grade index of tobacco leaves fermented electrically.

Waller (1900) and Waller (1924, 1925) reported that, when light falls upon a plant tissue, electricity is produced by the tissue under certain conditions. This photoelectric current is of interest on account of the distinct significance that it appears to possess in reference to plant metabolism. It was believed that the nature of the photochemical reactions in the plant may be indicated by this electrical response. This photoelectric response is shown mainly by the green parts of plants and is apparently dependent upon the metabolic activity of the chlorophyll, although it may occur in the absence of chlorophyll, as shown in the case of *Hydrangea* petals and in blanched celery.

Thouvenin (1896) claimed that the passage of direct current through *Elodea* stimulates photosynthesis. Pollacci (1905, 1907), and Koltonski (1908) observed that the effect depends on the direction of current. Stimulation occurring when the apex of the shoot was positive and inhibition when it was negative. Chouchak (1929) observed that corn leaves assimilated more CO_2 than ordinary when they were positively charged, and less when the charge was negative.

Gibson (1908) formulated a photoelectric theory of photosynthesis in which it was considered that formaldehyde is synthesized from CO_2 in the presence of water by feeble electric charges, which occurred in the photosynthetic tissues when adequately illuminated, the light energy being transformed by

the chlorophyll into electric energy. He considered that Loeb's (1905, 1906) experiment strengthened a part of this theory, and it has later (Dixon and Poole, 1920) been established that a slight photoelectric effect occurs in chlorophyll under illumination.

In 1914 Knight and Priestley reported that electricity has no effect on respiration. When higher currents were employed, a definite increase of the CO_2 output was observed. This increase, however, could be wholly attributed to the rise of temperature caused by the discharge and explanations of the acceleration of growth due to electricity must be sought in other functions of the plant.

Portsmouth (1934) found that the respiration rate in barley seedlings in ionized air increased about 2% over the control. Ionized air apparently had little or no effect on the rate of respiration in the leaves of geranium. Sapozhnikova (1928) reported that ionization of the air decreased the rate of respiration in the plants that he observed. De Boer (1930), however, could observe no effect of ionization on the rate of respiration.

In transpiration, however, Mercier (1946) reported an increase in the case of wheat plants subjected to a field of direct electric current.

Ostapenko (1958), working with hemp reported that by passing an electric current in the soil, polyphenoloxidase and peroxidase activities were reduced. The activity of these oxidases was affected most in the female plants in which it was already lower than in the male plants.

Not only the growth, physiology, yield and quality ; but their sex ratio is also altered, the alteration being even more pronounced in the progeny (Ostapenko, 1958). In the case of hemp plants examined, female/male ratio was appreciably increased.

Keeping in view the considerable work that has been done and the benefits that have been acheived, one can confidently say that this is a promising field of enquiry.

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STUDENT-TEACHER RELATIONSHIP

A. B. MISRA,

The relation subsisting between the teacher and the student is not that obtaining between a Capitalist *cum* Producer and the Consumer, although the teacher has a large reserve of intellectual capital and the student is the consumer of his ideas and knowledge. This fact has been insufficiently realised in the recent past and a spirit of Trade Unionism has developed in the centres of learning. During the last few years, several manifestations of a diseased attitude have been noticed, as for instance, in the periodic break-down of the student-teacher relationship, here and there, and practically every where. The reasons for the break-down of the sacred relationship are many and varied. It is not possible to dwell on them at length, because that will fill up many pages. From the time of the Sadler Commission Report in 1916 several other authentic documents have brought home to us the decay and the rot that has set in in our seats of learning. Anyone interested in the details may study the Sadler Commission Report, Punjab University Enquiry Report, the Mootham Report, the reports of the Inter-University Board, the Proceedings of the Vice-Chancellors' Conferences, the Proceedings of the Central Board of Education and the speeches of the high dignataries of the land. Whatever may be or may have been the cause, or causes of the *malaise*, nobody can feel happy with the existing state of things, nor can one afford to bury one's heads like an ostrich in the sandy heap of events.

A very thoughtful analysis of the factors that have contributed to the creation of the present mess was made by Governor Giri, who accused the politicians, teachers, parents, press, public, students and the Government-of-the-day as being equally responsible for the messy state of things. A large number

of factors have conspired to bring about the sorry state of affairs that we notice now, not the least important being the economic and the political upheavals caused by the two world wars and the non-violent non-cooperation movement launched by the Congress in 1919-20.

The world has changed a great deal since the beginning of the present century and it was not to be expected that whilst the caravan of world events will march on, we will stand still and let the caravan pass without joining its rear. The sixty years of the present century taken all together are characterised by saltatory advancements in Science and in Technology, and these years have brought about greater change in the fabric of our existence than the hundred years of the preceding century. Therefore, it was impossible for us to remain unaffected by the tide of time or the march of events that were engulfing us from all sides. It was not possible for us to remain in the stage of the bullock cart civilization, when the other half of the world was changing over to the age of the "Sputnik".

There are some educationists who decry the modern universities and educational institutions and laud the ancient *gurukulas*. But they forget that it is no longer possible for us to go back to the time of the *gurukulas*. Time moves on without halting for anybody and we cannot put back the hands of the clock. Evolution is generally said to be irreversible. Therefore, the modern system of education, with all its faults, has come to stay with us. It is open to us to make improvements in it and to shape it after our own hearts. We can, if we like, infuse a new spirit into it and effect improvements, here and there, in order that it may serve our present needs in a better way, but we cannot completely raise the existing structure to the ground and build it anew from the foundation. The experiment will prove to be too costly for us and will also be fraught with new difficulties and unforeseen dangers. We can follow the example of the American who buys an old English home or mansion and rennovates and reconditions it according to his own fancy. In the same way, we can improve the existing

universities, rehabilitate them with renewed energy and infuse in them a new spirit. The pattern of teaching can be changed and the pattern of life of the students in the university can also be altered, if and where necessary. With such changes and renewals and the grafting of a new heart, the universities will certainly wear a new complexion of freshness and vitality.

The university is not a pile of magnificent buildings. It does not consist even of "a large collection of books" with due deference to Francis Bacon. It is essentially a collection of teachers and students holding communion with one another in a calm and serene atmosphere. Lord Buddha taught his sermons only under the canopy of a tree at Sarnath. We have failed to realise that the university is a living *organism* pulsating with life. Wherever a great teacher and a number of ardent pupils shall gather together for discourse and study, a university shall spring up there. The relationship between the teacher and the student is of a very delicate kind and defies definition. It cannot be expressed in words. It is of endogenous origin and is regulated by its own rules of autonomy. In ancient India, the teachers (or *gurus*) were men of great merit and possessed towering personalities. They had the necessary State patronage undoubtedly but lived in the silent pursuit of knowledge. The students, who collected around them, were not job hunters either. The times and the circumstances obtaining then were, however, quite different. The *gurus* were spiritual leaders, and neither the King nor the parents dared to interfere with their administration of the *Gurukulas*. The guru's word was law. We hear of Viswamitra, Narada, Valmiki, Bharadwaja etc., as the great *gurus* of ancient India. Even in Europe, in the medieval period, the universities sprung up in relation with the churches. High priests and clergymen, who led a very ascetic and religious life and were wise in an uncommon degree used to attract a number of young men around them for initiation in the liturgical theology and the kings used to make land grants for the maintenance of the churches. Thus began the first universities in England and in Europe.

It will, therefore, be seen that the high and rarified atmosphere of the institutions, both eastern or western, was due primarily to the great personality of the teachers, their selfless existence, great scholarship and highly principled life and practices. Both in the East and in the West, the hold of the Church gradually declined, but, in place of the churches, there grew up great centres of learning which we now call universities. In India, we had the misfortune of the imposition of foreign rule for nearly 1500 years or so on us. Our ancient system cracked under this impact. Macaulay's Despatch granted us the English system of education, but its main purpose was to produce a large number of clerks and petty officers for running the governmental machinery.

A unique opportunity now awaits the young men because all the avenues of employment, from the highest to the lowest, are open to them. In our days, many a door was shut against us and it was only after 1919 (the Montford Reforms) that the Class II Service was liberalised and a few selected Indians were promoted to it. But the best services of the country were still manned mostly by the foreigners. Now it is possible for a young man of requisite qualities and abilities to reach the giddy top and the youth of the country must understand this fact clearly. When I hear of the so-called "frustration" among them, I confess that I do not understand it. Probably the frustration is due to the unbridled ambition on the part of those who are ill-equipped, unmeritorious and unworthy of the reward that they hope for. They constitute the most vociferous section and are the first to try to hitch their wagons to the stars. Another cause of frustration may be that, with the least qualification and effort, they expect the best fruits of life to fall in their laps.

We are living in the age of democracy in which the survival of the fittest is the rule. In this system, even the 'fit' and the 'fitter' will be relegated by the Natural Laws to a secondary or a tertiary position ; and only the 'fittest' will win the race.

I do not wish to minimise the part played by the schools and the universities in moulding our lives, but I have come to the conclusion that the initiative and the endeavour for improvement must come from within ourselves; otherwise, all effort aiming at improvement will be like rain and sunshine fallen on unbroken soil. Therefore, one ought to make a *conscious effort* to rise equal to the occasion, so that when the turn comes to bat the ball it is not missed. I am personally of the opinion that through self-discipline, self-introspection and self-culture one's mind can be so orientated as to reach right conclusions. A perfect degree of mental balance and training of the senses can be accomplished by means of a conscious effort at self improvement. In short, if we were to live an ordered life, then, by the force of habit, a disciplined mind will result. There would be no need for imposing discipline from without, if the young men realize that they have to battle through life and that they ought to prepare themselves not only for their own benefit, but also for advancing the common cause of humanity. There is no more beautiful life than that of a student and we must consider them lucky "who scorn delight and live laborious days".

If we were to cast our eyes enquiringly into the cause of greatness of some great men of our own days or of the times gone by, we will see that each one of them had travelled on the arduous road to fame by his own efforts, sustained, of course, by a will to achieve something worthwhile. The most important thing was that the wish to be good or great was born in them. It was not a compelling external circumstance that forged them into shape, but a *compelling will-power of endogenous origin* that prompted them, step by step, to score success in life. It is a mistake to suppose that the college, university or the teacher can lift any one skyhigh. All that they can do is to provide the *proper climate* in which the personality of the individual may blossom forth. A great institution or a great teacher can only provide the right atmosphere or stimulus. The case of Dr. Carver, a negro scientist of U.S.A. fame, is an instance in point of self culture. The story is told in a

recent number of *Span*. I have found the story of his life very instructive and rich in its contents and have, therefore, reproduced it here in an abridged form so that the truth of my argument, that all effort for improvement must be of endogenous origin, be proven.

George Washington Carver was born a slave. The date was 'around 1860'. His mother and father were slaves on Moses Carver's estate in Missouri.

A band of night-raiders once swept down on the Carver plantation and kidnapped little George's mother, who died from the terrible strain, and the tiny baby was left to the rough care of his kidnappers.

Agents sent out by Moses Carver came across the raiders. These agents offered race horse, worth about three hundred dollars, as ransom. The raiders......let the baby go back to Moses Carver's plantation.

The Carvers brought up the little orphan boy until he was ready to leave. In accordance with custom, he bore the name of George Washington Carver.

When......just a little dot, he thirsted for knowledge and wanted to know every stone and plant, and to learn about every animal, insect and bird.

An old blue-backed Webster's Spelling Book provided the young botanist's only education during his first ten years.

Moses Carver encouraged the tiny Negro boy to go the to school at Neosho. School work was fun. The shy, eager-eyed, smiling little Negro boy found odd jobs to keep himself clothed and fed. Within a year he had learned all that the teacher in Neosho's log school could teach him, and he was hungry for more.

One morning a stranger in a mule-drawn wagon offered him a ride to Fort Scott, Kansas. There was a high school in Fort Scott. George left Neosho without a backward look.

Abridged from Span, No. I, Nov. 1960, pp. 36-40.

Something out of Nothing by Alice Cecilia Cooper and Charles A. Palmer Publ. Harcourt, Brace & Co. Inc. U.S.A. Indebtedness is acknowledged.

Seven years later he graduated from the high school at Fort Scott. With his graduation from high school came also his graduation from bodily frailty. Within a year or two he had developed into a strong, healthy six-footer.

Later George applied by letter for admission into a college in Iowa. His credits were approved but when he arrived in Iowa for further schooling the college Dean did not admit *him*. George Washington Carver smiled sadly, and, with a heavy heart, slowly walked back.

After a year of working at odd jobs he was accepted as a student at Simpson College at Indanola, Iowa. In 1890 he enrolled at Iowa State College.

The authorities at Iowa State College were so impressed with young George Washington Carver on his securing B.Sc. degree in 1894, they offered him a teaching post in the chemistry laboratory. Two years later he earned the degree of Master of Science.

In 1897 the late Booker T. Washington, Head of the Tuskegee Institute at Tuskegee, Alabama, asked the young agricultural chemist to join his staff.

After two years at Tuskegee he took leave of absence to return to Iowa State College to earn his degree of Doctor of Science.

The first laboratory at Tuskegee was a triumph of enterprise. There was no equipment and no money ; but Dr. Carver was starting this undertaking *with nothing*.

Years passed before Tuskegee Institute could afford new equipment, but no one was happier than was Dr. Carver with his first plank benches and perfume- bottle test tubes.

The diminishing yield of cotton was serious menace. The boll-weevil attacked the fields and ruined nearly all the crop of cotton.

Dr. Carver concentrated on the situation as earnestly as possible. After long and careful chemical analysis, he advised them to plant sweet potatoes, or better still, to plant peanuts.

He published the startling results of *crop rotation* and Dr. Carver raised a 500-pound bale of cotton on a single acre of that abandoned land. But soon there were more peanuts than the market could buy. So prices began to fall.

Dr. Carver first produced a dozen, then fifty *brand-new products* from the peanut and then many more.

Next he tackled the sweet potato with the same scientific thoroughness. Soon Dr. Carver was able to serve a complete meal, including "coffee" and tapioca for dessert from sweet potato products alone.

The First World War saw "wheatless days" in U.S.A Dr. Carver was experimenting, at that time, with a *flour made from sweet potatoes*. When the process for making the flour was perfected, he gave it to the government for use in the army. It was used with great success.

When the peanut planters were harassed by a disease which threatened to ruin their peanut crop they sent specimens to Dr. Carver who discovered a cure.

Dothan, Alabama, is the capital of the Peanut Belt. In 1900 it was a sleepy town of about 3,000 population. By 1937, it was a bustling city of 20,000 prosperous people. In 1900 scarcely fifty tons of peanuts were grown in the whole world. Soon the area within fifty miles around Dothan alone was producing 75,000 tons of goobers. From a worthless crop, peanuts grew into a million-dollar-a-year industry.

In 1923 he was awarded the Spingarn Medal, presented annually for the most distinguished achievement by an American citizen of African descent.

Anything that might be considered agricultural waste provided a starting point for Dr. Carver. He developed *synthetic rubber* tyres from cotton stalks, *potash* from china-berry tree ashes, *silk* from poplar bark, and *synthetic marble* from wood shavings. It never occurred to him that he could stop working and retire. He never owned an automobile, or even a hat. His favorite mode of travel was on foot, his

apparel was an old checked cap, slouchy dark coat, and baggy, speckled pants. It was only with the greatest difficulty that his colleagues induced him to wear the academic cap and gown even when a bronze plaque in his honour was unveiled at Tuskegee in 1931.

In 1939 the Roosevelt Memorial Award was granted to Dr. Carver. The following year he himself gave away every penny of his savings towards the founding of the Carver Creative Research Laboratories which were being built at Tuskegee Institute.

George Washington Carver died in 1943, leaving a sizable amount of money in uncashed cheques for the benefit of young Negro scientists.

The example of Dr. Carver is such as to serve as a guide to many a young man.

Recently, we have seen how frayed the nerves of the leading politicians of the world are and from that we can infer that, if we are not to be reduced to ashes and shambles, then there is an imminent need for sober, upright and thoughtful men in this world. While one is young, one has the time and the opportunity to fill one's mind with good and noble thoughts and to prevent Satan from finding some michief for the idle hands to do.

Many of the conflicts that have arisen in recent times between the students and the teachers are due to the fact that most of the students, who pass through the university, have no purposiveness in life. They simply drift from one stage to another without acquiring a meaning in life. The society has much to fear from such men for they are just free lancers and nothing more. They fill their minds with all kinds of quixotic ideas that have no relationship with the realities of life. The El Dorado that they picture in their minds is not to be found anywhere except in their own imagination and slowly they consign themselves to a sense of defeatism. One of the most

difficult and sore problems in life is the procurement of bread. One cannot march very long or very far on an empty stomach, and a hungry man is so corruptible that there can be no floor limit to his inglory. Psychologists tell us of the ruinous behaviour of a hungry man. When money jingles in the pocket and when the stomach is full, only then does a twinkle appear in the eyes.* Therefore, it is not profitable to be a day dreamer.† It is much better to be a realist and to occupy a small station in life than to suffer from day dreams. To lead a sober, contended and clean life is an achievement that one may look for. Even for acquiring this modest status in life, a great deal of discipline, endeavour and restraint in life is necessary.

The Indian tradition of studentship is one of austerity, frugality and humility. Our ancient literature abounds in instances of pupils of princely origin being handed over to the *rishis* for training. The common age of entry into a *gurukula* was nine years. From that date, the pupils belonged to the guru's *kula*, that is to say, the family of the guru, and the pupils even wore the guru's name as a surname, which has survived even now, after the lapse of thousands of years of changing history, in the form of *gotra*. This system, when analysed in the context of present day affairs, acquires a great meaning. The pupils were then unconditionally handed over to the gurus and in the gurukula they used to perform all kinds of duties without a demur and became members of the dormitaries (the *ashram*) which served as a well-knit unit. At the age of twenty-five, the guru blessed the pupil to go back home to lead the life of a *grahasta*. The name of the guru's kula was affixed to one's name, generation after generation, somewhat like the present-day contraction of Oxon., Cantab. and Lond. fondly displayed by our modern youths. Because the pupil

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*It is said that

जब जेब में पैसा होता है, जब पेट में रोटी होती है।
उस वक़्त ये जर्रा हीरा है, उस वक़्त ये शबनम मोती है।। —जज़्बी

†आसान नहीं इस दुनिया में, ख्वाबों के सहारे जी सकना।
संगीन हक़ीकत है दुनिया, ये कोई सुनहरी ख्वाब नहीं।। —साग़र निज़ाम

became a *samgotri* with the teacher, he became a kind of adopted child of the guru, and, therefore, a *sapindi.* If further proof of this noble relationship between the teacher and the taught is needed, then evidence from the rituals of the *saradha* and the *pimdadan* is available to sustain my arugment. The spirit of the ancient system has managed to survive in the form of a ritual which many of us perform without knowing it. In the annual *shradhanjali*, at the time of *pindadan*, when the *pinda* is offered to the parents, grand-parents and the great grand-parents etc., and the collaterals, the *guru* is not forgotten. A *pinda* is offered to him also in the same way as to one's ancestors. The meaning of this practice, which is observed by us even now, is seldom realized now because most of the offerings are recited in Sanskrit. It will, therefore, be seen that our fore-fathers placed the guru on a very high pedestal in the social hierarchy. I remember to have read somewhere that the high esteem and reverence in which the *gurus* were held in Ancient India was based on the conception that whilse the parents could give to the child only the corporal endowment, the guru imparted him the intellectual instruments (Gnana or know-ledge), without which the corpus could only be a lump of flesh. Without knowledge (or *Gnana*) it is difficult to conduct oneself through the voyage of life. Therefore, in our culture, the *guru's* place is even higher than that of the natural parents. It is a general custom in Indian households to symbolise the great line of the *gurus* by deifying Ganesha, and, in every sacred ceremony, the *guru* is given a place of honour and worshipped because he is worshipful. In our culture, the guru, on account of his high intellectual and spiritual attainments has also been deified and that is why the appelation of *guru deva* has gained currency in our language. There is an excellent versified hymn in Sanskrit which many of us know.

"Tumeva mata cha pita tumeva
(You are the mother and the father)
Tumeva bandushcha sakha tumeva
(You are the friend and the clan)

Tumeva vidya, dravinam tumeva
(You are the embodiment of knowledge and the treasure of treasures)

Tumeva sarvam mam deva deva
(You are all in all to me).

When a pupil addresses his teacher like this, he completely surrenders himself to the *guru*. The wall between them is dissolved.

Old times are changed, old manners gone ; but we have to catch up the old *spirit* in order to resuscitate our decadent society.

There is too much of froth and foam, bluster, pompousness, mirth and glee in the life of the average student at present. They believe the shadows to be the realities and chase them with all the ardour of youth forgetting the path of the golden mean and also forgetting that a straight line is the shortest route between any two given points. A seeker of knowledge can ill afford to fritter away his energies in idle pursuits and in a wild goose chase. Did not Thoreau write that "the really diligent student, in one of the crowded hives of Cambridge College is as solitary as a *dervish* in the desert". Here is some food for thought by the youngmen. A homely English proverb* recommends only six hours of sleep, four hours of prayers, two hours of feasting, six hours of serious study and the remaining six hours for light reading and diversion. Modern students seldom pray, sleep for more than six hours, read as little as possible and waste the rest of the time in fun and frolic, or else in a noisy and meaningless existence. Some of you may be aware of the chastizing lines of Southey† according to whom the repose of the night ought to be earned by attempting to do something by day and by even partially accomplishing it. The

*Six hours to sleep allot ; to law be six addressed. Pray four : feast two; the Muses claim the rest.

†Something attempted, something done,
Had earned a night's repose.

meaning of the English word 'earned' is perhaps not understood by us. Notwithstanding the gloomy state of affairs existing today, improvement is not ruled out in our educational institutions. In every institution, big or small, there are still a few men who are the salt of the earth but they have to be discovered. The young students with their sharp wits and fertile minds can turn their energies to good account by going out in search of the right kind of teachers, and, having found them, to sip the nectar of knowledge at their feet. Should one happen to find a teacher of the right sort, one ought to go to him in sack cloth and ashes, with humility writ large on the forehead.* I am sure he will fill the begging bowl with the "manna" of knowledge and one's thirst will be duly quenched.†

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*Sie sind Voll, Honing die Blumen ; aber die Biene nur findet sie Sūssigkeit aus. (German proverb)

Many a flower are full of honey, but only the bee finds them out. Therefore, like the bees make a straight-line to them. (Translation)

†तमन्ना इल्म हासिल की हो तो कर खिदमत फ़क़ीरों की,
नहीं मिलते है यह गौहर वादशाहों कें खज़ानों में। —इक़बाब

A MODERN APPROACH TO THE STUDY OF HISTORY

G. C. DAS

The conformity of history to text-book specifications has put it in fetters tyrannical. It no longer remains 'the true poetry' as Carlyle conceived it. From one's early childhood one grows to look on history as 'a confused heap of facts'. At schools and colleges our students have to cram dates of wars and names of royal dynasties. In all this, one misses the soul of history. Though it is 'a register of crimes, follies and misfortunes of mankind', yet it is a sacred writing, 'for truth is essential to it' according to Cerventes. Truth is apprehended through insight-occasionally, through the penetrating insight of the poet who seems to pierce to the heart of things and to anticipate the verdict of history, as it may fairly be said that Marvell did in speaking of Charles I and Cromwell. Swinburne also did the same when he wrote of Mary Queen of Scots. The tomes which our historians fill with details about the exploits of kings and conquerors betray a miserable lack of this insight which is really an asset to them. Insight, imagination and impartiality are the three essentials required of a professional historian anywhere. If these elements along with a vital touch of human sympathy come into play to bring the past into life history will, undoubtedly, be what Carlyle or Cerventes thought of it.

It is the age of Marx, Spengler, Wells and Toynbee. The historian of today should take his cue from these masters and renovate the entire art of historiography so that the soul of history may be rescued from its present state of constraint lest it should be crushed out altogether. The fact that history moves in cycles and a writer of history has to deal with civilizations and not with countries and wars should in no case be lost sight of.

Addressing the session of Indian History Congress in Delhi in the last week of January last year Mr. Nehru told the historians what history should mean in the context of present-day life and how they should deal with the subject-matter. It would appear that he has stressed the obvious. But he has done so because he practises what he says. In fact, our historians have yet to adapt themselves to the ways suggested by Mr. Nehru who in his books on history has shown a far geater insight into the happenings of the past than many a prefessional writer of history. Most of these specialists, who write for the enlightenment of the citizens of tomorrow, are lost in the mere accumulation of facts with little or no capacity to interpret or correlate them. A very few of them only can claim to have produced a simple, coordinated account of even a single period in the country's life*. They can render great service to the nation by enabling it to understand its past and present better. This is possible if they undertake the task not as mere compilers of records but as interpreters of the eternal march of events.

The great historian-philosopher Professor Albert Guerard in his fine volume on 'France' has given an excellent definition of history : 'History is the conscious, methodical, critical memory of mankind. It preserves, and often has to recapture, the life of the former days'. Like our own, life of our forefathers was made up, of suffering and health, of industry, rest and enjoyment, of ambitions and frustrations, of love and quarrels, and in an appreciable measure, of wonders, awe and worship. These things are of imperative necessity 'under the changing pageant of customs'. In all this, governments play a minor role.

Even today, conscious as we deem ourselves to be of our civic responsibilities, most of us give little time and less thought

*The most interesting historical work I have read for some years is 'The Wonder That was India' by A. L. Basham (Grove Press Inc., New York, 1954). It is an encyclopaedic survey of the cultue of the Indian sub-continent before the advent of the Muslims. It is a profusely illustrated and competently written work of distinction.

to matters of public importance. We mechanically vote every five years on national issues, we glance at a few items of political news in the daily papers, we listen for a few minutes to a radio announcer and have the complacency that we have done our share. One thing is, however, certain that man's chief concern never was to support or overthrow governments. So political history records but a small fraction of our collective experience. To quote Professor Guerard again: 'Political events have their roots in civilization and culture, the sum-total of a people's activities. Detached from these realities, the annals of courts, armies and parliaments would be futile'. Relations between races are generally determined by cultural tradition and this tradition varies greatly in the course of centuries. History, after all, does not simply mean knowing the sequence of the events.

R. G. Collingwood, whose life's work in the main has been an attempt to bring about a rapproachment between philosophy and history, calls history 'the science of human affairs'. The strivings and rivalries of individuals and groups would be of little significance if we do not discern great issues at the back of their deeds and words. In this context Collingwood observes: 'We study history in order to see more clearly into the situation in which we are called upon to act. Hence the plane on which, ultimately, all problems arise is the plane of *real* life: that to which they are referred for their solution is history.' In rethinking what somebody else thought, the historian thinks it himself. In knowing that somebody else thought it, he knows that he himself is able to think it. Voltaire saw with matchless clarity that if history is to be intelligent it must be all-embracing. 'Man', says G. V. Plekhanov, 'makes his history in striving to satisfy his needs'. This is materialist view of history. According to Dialecticians it is needs that determine man's actions in various walks of his life and this is how the history of a nation is made.

History, too, for all that it has its scientific side in the assembly and evaluation of material, is in the last resort a part

of the art of writing. Incidentally, a fine example of such writing we have in a remarkable book* on the study of Indian history by Professor D. D. Kosambi. 'This is how history should be written but seldom is', opines Robert Graves about this book, which amply deserves this praise. The most arresting feature of the book is its novel approach to the study of the subject. It is not an historical work itself, but prepares the readers to study Indian history methodically themselves. Unlike the history of a western country Indian history has taken a tortuous course during the sweep of centuries. Our ancients have left precious little in the way of history. The two epics and the Vedas contain much historical material, but strictly speaking, these are not historical works. We have no Herodotus, Livy or Tacitus. It is, therefore, necessary that special methods should be employed for a systematic study of Indian history. Professor Kosambi's book is an intelligent guide to earnest readers. Knowledge comes only by answering questions, and that these questions must be the right questions and asked in the right order. The writer has followed this line successfully in preparing the book. He has answered the questions that have been agitating the minds of scholars for sometime now and has also raised new ones. In this survey of the movement of the course of events from a prehistoric tribal society to the machine age he has been able to reconstruct a fairly full, if not the precise, picture of the past considered in all its bearings on the present.

The writer of Indian history has to face heavy odds at every step. The material he has to deal with is vast and is of diverse nature. Only a person endowed with a critical acumen of high degree can perform the irksome task of sifting and scrutiny in search of fact and meaning 'taking nothing for granted or on faith'. In planning the book Prof. Kosambi has considered the economic facts in their social and political background laying an unusually great emphasis on them. This shift of emphasis on particular facts becomes the striking feature because

*'An Introduction to the Study of Indian History' by D. D. Kosambi (Popular Book Depot, Bombay 7, 1956).

Prof. Kosambi has made it the principal *motif* of the book. He has put too much reliance upon the materialistic interpretation of history after Plekhanov. Hence, philosophy and religion which go to form the collective national spirit do not figure in the plan, as they fall in the category of 'pure mysticism'. It makes the book somewhat lop-sided. But for this the volume in question is a notable contribution to modern historiography. Within the well-defined scope of each of the ten chapters the author discusses the persistent problems and topics relevant to the study of Indian history. A chronological outline, sixty-four illustrations (with commentary), and notes make the work really useful and leave nothing to be desired.

In the contemporary world the role of an historian is very great indeed. He graps the meaning of the past and observes the handwriting on the wall of time for the benefit of the common man. The responsibility to deliver the message of history devolves upon him. For example, the message of Indian history, as interpreted by Arnold Toynbee in his Azad Memorial Lectures, is to cultivate 'a spirit free from rancour, that is catholic in belief. It sees many in one, and reaches its flowering in non-violence as a belief'. This spirit which belongs to an ancient tradition should survive to fulfil its historic destiny for the well-being of humanity.

BIOLUMINESCENCE: NATURE'S LIGHT GALORE

R. RAJAGOPAL

Amongst the myriad phenomena of Nature that constitute a constant challenge and a perpetual store of curiosity, bioluminescence or the production of light without heat by living organisms has rarely, if ever, failed to excite our wonder and admiration. It has attracted the attention of man ever since he began to think though no concerted attempt on a scientific basis appears to have been made till the 17th century to study the mechanism of this light production.

Bioluminescence should be clearly distinguished from kindered phenomena like phosphorescence and flourescence. Whereas flourescence refers to objects or organisms that glow only during the duration they are irradiated, in phosphorescence radiant energy is absorbed and later on released in the form of light. In the latter case therefore, emission of light may persist for a short time even after the source of light is removed, as an after-effect of preillumination ; but the ability to produce light is not inherent. Not so bioluminescence which is the outcome of functional activity, a by-product of oxidative metabolism of living organisms.

From *Protozoa* to *Chordata*, the ability to produce light has been developed by a great number of diverse organisms ; its widespread occurrence is evident from the fact that no less than 13 phyla and 28 classes, out of the 33 phyla and 80 classes that comprise the animal world, have luminescent representatives. Prof. Newton Harvey of Princeton University who has been conducting research in this fascinating field for more than 40 years, is of the opinion that all the members of the phylum *Ctenophora* are perhaps, luminous. Contrariwise, the only luminous representatives of the plant kingdom are to be found among the bacteria (*Schizomycetes*) and the higher fungi (*Basidiomycetes*).

Totally unrelated forms possess the capacity to emit light. Even within a genus, one species may be luminous whereas another closely related member may be conspicuous by the absence in it of even a trace of luminosity. It is indeed noteworthy that luminosity is characteristic of not only the adult forms but the embryos and even the eggs of some species such as *Lampyrus* and *Pyrophorous* exhibit this ability. Considering the scattered distribution of this phenomenon in the fauna and flora, one is struck by the extraordinary but apparent fact that this development has come about in a haphazard manner and not along strictly evolutionary lines as is usually the case with inherited characters.

All the luminous organisms known at present can be grouped under two broad categories, namely aquatic and terrestrial. The majority of the marine forms are found at great depths and very often complicated luminous organs are encountered among these. Peculiarly enough luminous species thrive only in salt water and fresh water specimens are almost unknown (the only exception being *Latia neritoides*, a herbivorous snail found in New Zealand). Among the dinoflagellates-unicellular, motile algae possessing two whiplike flagella-light emission is associated only with the salt-water species.

Emission of light may be intra-or extra-cellular. In the latter case the material responsible for the production of light is secreted to the exterior and is burned outside. Organisms with intra-cellular luminescence are usually equipped with quite complicated organs such as lenses, reflectors and colour screens for properly adjusting and directing the light.

Continuous light emission is commonly associated with certain bacteria, fungi and fish whereas others glow only upon stimulation which may be internal (through nerve impulses) or purely external comprising mechanical, chemical or electrical influences. Inasmuch as most of these animals are nocturnal, they exhibit a remarkable periodicity of luminescence. Fireflies are rarely seen during the day while *Cypridina*-a member of *Crustaceae*-does not prowl about even at night when the

moon is shining. An extreme case of diurnal rhythm of light production has been reported to occur in a worm-like marine animal (*Ptychodera*). Even in total darkness it is difficult to stimulate this animal to luminesce during periods which correspond to day. Brilliant luminescence, however, is observable at the slightest touch of he organism during hours corresponding to night.

The light produced by all these organisms falls strictly within the visible spectrum though the colours emitted may be different in different species. As a consequence, an endless panorama of variegated shades and colours is presented, amazing and awe-inspiring. *Noctiluca miliaris*, a luminous dinoflagellate, collects in such enormous numbers on the surface of the sea that even during the day a pink or red hue is imparted to the sea-water for miles around and, "shines like a sheet of fire when disturbed at night". For sheer pyrotechnics however, the firefly squid (*Watasenia scintillans*) abounding in the sea around Japan, is incomparable. Besides a number of luminous organs on the arms and eyes, it has numerous small spots scattered all over the body and at night all these spots light up with a brilliant luminescence as though competing with the celestial bodies. As if this were not enough to kindle our curiosity, this animal can shut off the light at will from every pore on its body by means of thin membranes known in scientific parlance as chromatophores.

Perhaps the strangest of all such creatures is the 'railroad worm'—the larva of a beetle '*Phrixothrix*'- of widespread distribution in Latin America. This organism possesses the unusual ability of producing light of two different colours, namely red and green. Eleven pairs of luminous organs are symmetrically arranged in two rows on its segmented body and from these on excitation, emanates a greenish-yellow light. Besides, it has a pair of luminous spots on the head which emit a red glow. Curiously enough, when at rest there is no emission of light whereas at even the slightest disturbance as knocking the table gently or blowing air over it, the red headlight is

switched on and the animal looks like a burning cigarette. Upon severe disturbance, however, all the eleven pairs of green lights start shining and a veritable display of green and red light illuminates the immediate environment. As the worm regains its composure and becomes quitened, the green lights disappear first but the headlight persists to glow for sometime. Perhaps a warning signal that all is not yet well with the worm!

In many instances it so happens that the observed luminescence is not due to the animal concerned but due to contaminating bacteria. This is a common occurrence among tropical fish notable among which are *Anomalops katoptron* and *Photoblepharon palpabratus*. These have specialised, crescent-shaped light organs just beneath their eyes in the form of pouches in which luminous bacteria collect even during the embryonic stage. How they happen to collect there is still a mystery. The fish supplies oxygen through its blood to the bacteria and the latter in turn emit light continuously and the association therefore amounts to a true symbiosis. The fish have black membranes and these when drawn up, turn off the light whenever not required.

Because of the little heat given off, bioluminescence is often referred to as 'cold light'. That it is an enzyme-controlled biochemical reaction has been amply proved by elegant laboratory demonstrations with extracts from fire-flies. The substrate of the reaction is a yellow-green flourescent compound termed 'Luciferin' and the enzyme responsible is called 'Luciferase'. These two compounds can be extracted with suitable solvents from luminous animals and when mixed in a test-tube with a little magnesium and adenosine triphosphate (ATP), a brilliant flash of light results. ATP is an organic compound of ubiquitous occurrence and is the chief transporter of energy within cells. During respiration it changes to adenosine diphosphate (ADP) and in the process liberates energy, partly chemical and mostly heat. In luminous organisms however, a portion of the energy so liberated appears in the form of light. Thus we have the living light of the firefly, of the deep-

sea angler fish and countless other organisms. It is interesting to note that the fatal electric shock of the torpedo fish (*Electrophorus electricus*) is also mediated through adenosine triphosphate.

Light production entirely ceases in the absence of oxygen indicating thereby the highly aerobic nature of the process. It is also inhibited by certain chemical toxins like cyanide, azide, flouride etc. which interfere with some steps in the respiratory metabolism, thereby stopping the flow of energy. Such a susceptibility to inhibitors coupled with other more elaborate evidence has led to the firm conclusion that bioluminescence is just a by-product of oxidative enzyme reactions intimately connected with the life of the cell.

The luminous material of practically all the organisms can be dried and kept in the powdered form for an indefinite period without destruction of the basic materials necessary for the production of light. Prof. Harvey reports that such dried powder of *Cypridina* is potentially luminous even after 30 years of storage. On moistening this powder light is given off ; even one part of *Cypridina* in 400 million parts of water will give off light that can be visibly seen.

An insight into the hereditary factors responsible for the transmission of this character from generation to generation was provided by genetic studies on a wood-destroying, mushroom fungus, *Panus stipticus* (*Agaricaceae*). There exist two varieties of this species-a North American form that is luminous and an European counterpart that is not. Morphologically both the forms are similar but physiologically they are dissimilar. By crossing these two varieties, it has been ascertained that the luminous character is inherited by a single dominant gene.

More complicated and puzzling than the mechanism is the significance and possible use of bioluminescence to the animal concerned. For marine organisms living at great depths in almost total darkness, it is conceivable that this light may be of use not only for illumination but also in recognising other members of the same species. It may even be possible that

this light serves as a defence against attack by scaring away predators or attract small animals on which the organism itself may feed. In the case of fireflies however, it is well known that this light acts to bring the two sexes together for mating. The light produced by bacteria and fungi, according to the consensus of opinion, serves no useful purpose but is merely a by product of oxidative metabolism. Strong support is lent to this view by the fact that some bacteria and fungi lose their ability to luminesce under certain cultural conditions.

Strange as the phenomenon is, stranger still are the uses to which it has been commandeered. From time immemorial the natives of East Indies have been using the light organ of *Photoblepharon*, already referred to, as a bait in fishing. Beijerinck, a pioneer bacteriologist, used luminous bacteria for detecting cracks in bacterial filters. A suspension of such bacteria is passed through a suspected filter. If there is a crack, the bacteria will pass through and betray their presence in the filtrate by light emission. A sound filter, on the other hand, will keep back all the bacteria.

The manufacture of food in light by green plants is called photosynthesis and during this process oxygen is liberated. As far back as 1928, Harvey demonstrated this fact through the medium of luminous bacteria which glow only in the presence of oxygen since bioluminescence is an exclusively aerobic process. The utility of this phenomenon appears to be known even to some birds. Weaver birds, for example, seemingly possess the uncanny ability to hunt down fireflies and stick them to the roof of their nests thus illuminating their otherwise dark abodes! In Japan, about 1,000 tons of the firefly squid (*Watasenia*) is collected annually and used as manure to enrichen the soil for crop growth.

INSECTS AS HUMAN FOOD

S. P. MUKHARJI

The man enjoys more freedom in the choice of food than other animals without restriction and many curious anthropoids like prawns, crabs, lobsters and shrimps subsist as palatable and nutritious food among the rich. The primitive races and certain poorer backward tribes, however, on account of their poverty still consume insects in different parts of the world even to-day.

The races like the Western Indians, the Mexican natives, the Indian tribes of North America and the aboriginals of Australia are mostly the insect eaters. The Cantonese and the people of Peiping are the chief insect eaters among the Chinese. The backward tribes of South India, Bombay, Assam and in certain parts of Arabia and Africa regard the insects as the most favourite and higly delicious items of food.

That the insects still persist as their food is only because of their poverty and the scarcity of other morsels of food. The insects are abundant in nature and can be easily gathered, therefore, an idea of economy is naturally foremost in the minds of these insect eating people.

It is said that the insects possess genuine food value and is rich in salt content, which can supply the necessary food requirements.

The nutritional value of insects as food can be further established by the facts that there are several instances in other animals which live upon insects only and sustain their lives on this food alone.

The lower mammals like ant eaters subsist on ants only. Several insectivorous birds and reptiles such as lizards simply live upon insects. There are some entomophagous insects which prey upon other insects as food and are known as predators.

In South India, the winged termites and the queen termites are collected in numbers and are dried in the sun to detach wings. These are sold in the market and the people eat them either raw or cooked. The queen termite, being bulky in structure, is the most favourite food.

Locusts and grasshoppers are well known items of food in many parts of India and Arabia. In swarming times these are easily collected in good quantity. Sometimes these are cooked in boiling water and fried in butter. The Cantonese and the people of Peiping cook grasshoppers in sesamum oil and they are very found of these preparations. Osborn[1] states that "there is also the Biblical record that on occasion John: the Baptist subsisted on 'locusts and wild honey". Hoffman[2] gives a good account of these insects used as food in connection with the commercial use of insects.

The grasshoppers, maggots of Tipulids, aquatic flies, wood boring beetles form staple food among the primitive races and the Western Indians. Larvae of Rhinoceros beetles and the cockchafers are fried with a little salt and pepper and are consumed by many of them.

Mostly the Indian tribes of North America and the aboriginals of Australia use the Lepidopterous and coleopterous insects in their normal diet. They also eat the insects of other orders.

The water bug *Corixa* is a favourite food and a diet among the Maxican natives. These are also sold in the market as bird's food.

Though the Hydrophilid and Dytiscid beetles are offensive in smell but the Cantonese and the people of Kwangtung Province in China prefer them to take mainly as medicine. The insects are dropped in hot brine. The elytra legs and certain other chitinous structures are discarded before eating.

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1 Osborn, H. (1952): A brief history of Entomology, Columbus, Ohio, The Spahr & Glenn Co., 1952, p. 13.

2 Hoffmann, W. E. (1947): Proc. Ent. Soc. Wash. Dec. 1947, Vol. 49, pp. 233-7.

The giant water-bug *Lethocerus indicus* is also a favourite food for them and they prepare it in the same manner with a little addition of salt.

In Canton, Hongkong and Shanghai these bugs are displayed in large cylindrical jars in various shops for sale.

The Cantonese also prefer the green bottle fly larvae *Chrysomyia megacephala* Fabr. but this reflects a possibility of germ intake as these caterpillars are scavengers and breed on putrid meat.

In almost all the silk districts of China, in Kwangtung Province and South China, the roasted silkworm pupae are extensively used as food and even sold in the market. The silk cocoons are dropped in boiling water for reeling silk fibres and when the entire silk thread is wound up in the reels, the roasted pupae are exposed in the boiling water and the reeling girls take them mouthful while working on the silk reeling machine throughout the day.

The fungus of the genus *Cordyceps* which infect Hepialid and other caterpillars are considered as tonic food in Szechwan Province in China. A broth is prepared out of it and both the broth and the caterpillars are consumed.

The stink bugs emit the most obnoxious and repulsive smell but these are preferred in certain parts of Africa, Mexico and India. The natives of certain districts in Eastern Transvaal consider certain large plant bug a great delicacy and eat it either raw or cooked.

Among the edible Pentatomid plant bugs there are five genera belonging to the sub-families *Coridiinae, Pentatominae* and *Tessaratominae,* which are generally used as food.

Certain species of *Coridiinae* and *Pentatominae* bugs are eaten in some parts of India, Mexico while the *Tessaratominae* bugs are consumed in Africa.

The stink bug *Cyclopelta subhimalayensis* Strickland, is eaten with rice by backward tribes in Assam.

The use of insects as food among these less civilized races clearly show that there is no harmful effect on them and the insects do possess the nutritional value as food like that of prawns, crabs, lobsters, shrimps etc., which are eaten by the common people. The colouring matter of the fancy sweets, which are now-a-days very popular in the market and are relished by both the children and the old alike, is obtained from cochineal, a product derived from the pulverised bodies of certain homopterous insects.

Though it seems repugnant, but there is little reason except prejudice that the insects should not be included as one of the items of food.

The ever increasing population is causing a severe headache to the Economists of the world to-day on the problem of food. The rate of increase in human population is in less magnitude when compared to that of insects. The insect population is more alarming which snatch away more of our food crops yearly and is responsible for the food shortage. Therefore, the scientists of the future may well turn their attention to find out the real food value in insects and to the proper utilization of certain kinds of selected insects as natural or artificial food substitute.

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THE GANGETIC DOLPHIN

C. J. DOMINIC

The Gangetic dolphin or *Suis*, as it is called in Hindi, is one of the most interesting elements in the freshwater fauna of the Indo-Pakistan subcontinent. Its zoological name is *Platanista gangetica*. Beddard thinks that "the Indian vernacular name is derived from the sound that the animal makes when spouting". This humble dolphin is a close relative of the mighty whales and is like them the most perfectly aquatic of all mammals. Unlike its better known relatives—the giant whales of the seas—the Gangetic dolphin lives exclusively in fresh water. It is found in the three major rivers of Northern India, viz. the Indus, Ganges and the Brahmaputra, with all their larger tributaries, from the sea to the base of the mountains. This dolphin is common in tidal waters, but seldom enters the sea. It is interesting to note that two other dolphins belonging to the Family *Platanistidae* also live in freshwater, viz. in the rivers of South America.

It is highly probable that like the majority of its relatives-the whales, dolphins and porpoises-the Gangetic dolphin was once marine and widely spread and that it owes its survival partly to its adaptation for a life in rivers, where the struggle for existence is less severe than in the sea. In this connection it is pertinent to quote the remarks of B.N. Chopra, who with many others believes, that "changes in the configeration of land and sea during the Pliocene and the Pleistocene have left many marine relicts in the fresh-water fauna of India. The fresh-water dolphin, *Platanista gangetica*, not only reminds one of the Siwalik or the Indo-Brahm river of early Pleistocene but takes us back to the time when the bed of the Tethys sea began to rise and lagoons were formed which ultimately became fresh-water lakes".

It is really disappointing to learn that very little study has been made on this freshwater cousin of the whales. Our knowledge about this dolphin is mainly based on the observations of some European naturalists—especially those of Anderson, who in 1878 gave a good account of the anatomy, distribution and habits of this animal.

The Gangetic dolphin is a miniature whale, with its fish-like form, the pectoral flippers and the dorso-ventrally flattened tail, which is the chief propelling organ. As in the whales the external nostrils are placed on the dorsal side of the head. The skin is slate-coloured or black, smooth and hairless with a layer of fat (blubber) beneath. The head is low and rounded and the neck is distinctly indicated. The snout is very long and pointed. There are about twenty-nine conical teeth on each half of each jaw. The most important peculiarity of the skull is the development of a pair of enormous maxillary crests on the dorsal side. The long snout of the *Suis* has been compared to the long snout of the *Gharial*, a native of same region.

The size of the Gangetic dolphin is somewhat variable. The adults usually measure 7 to 8 feet in length. Blanford reports that a specimen from the river Jamuna in the Allahabad Museum measured 12 feet. Females are always larger than the males of the same age.

According to Anderson, the Gangetic dolphin is not gregarious, although several individuals may be seen about in the same part of the river. This seems to be a questionable statement, as this dolphin is usually observed moving in groups during the summer months of March, April and June in the river Ganges at Banaras. It keeps chiefly to the deeper waters and is probably migratory to some extent, as few individuals are seen from March to June in the river Hoogly at Calcutta, though many may be noticed in the months from October to March. During the rainy season (June to October) this dolphin remains in tidal waters around the mouth of the Hoogly, for it is frequently captured by fisherman, though it is seldom

observed. Like other dolphins and whales it rises to breath remaining only for a very short time at the surface. Sometimes in the winter months, it is observed to leap itself out of water.

Anderson kept one dolphin in captivity for ten days and carefully watched its respiratory act. He remarks that "the blow-hole opened whenever it reached the surface of water. The characteristic respiratory sound was produced, and so rapid was the inspiration that the blow-hole seemed to close immediately after the respiratory act......The respirations were tolerably frequent, occurring at intervals of about one-half or three-quarters of a minute, and the whole act did not take more than a few seconds for its fulfilment". But Sterndale thinks that "it is probable that in a free state and in perfect health, the animal remains longer under water. It has certainly been longer on several occasions when I have watched for the reappearance of one in the river".

The food of the *Suis* consists of fish and prawns. Anderson found in the stomach of a dolphin, he examined, the remains of mud-haunting catfishes. Grains of rice have also been found in the stomach, but this would seem to be accidental. A curious thing about the Gangetic dolphin is that it is quite blind. The eyes are vestigeal and devoid of the lens. This blindness may be correlated with the environment in which it lives. In this context R. S. Lull remarks thus : "the peculiarity of this eight foot whale lies in its blindness, as the muddy rivers and its habit of groping in the bottom mud for the crustaceans and fishes which form its food render sight of little value". Blanford also thinks that "sight would be useless in the thick muddy waters of the Indus at all times of the year, and of the the Ganges and Bramhmaputra at most seasons. Doubtless these (the fishes and crustaceans which form its food) are captured by the *Platanista* feeling for them on the mud with its snout".

Our knowledge of the breeding habits of the Gangetic dolphin is very fragmentary. The breeding season is said to

be in the months of July, August and September. Copulation is probably effected with the animals lying breast to breast, either horizontally on the surface of the water or in a vertical position. The male is said to hold the female in position by its flippers. We have little information on their courtship and pre-nuptial play. The period of gestation is about eight or nine months. The young, almost always one in number, very rarely two, are born between April and July and it is stated that the young dolphin at times holds on by its mouth to the base of the mother's flippers.

The Gangetic dolphin is said to be very timid and avoids human beings as far as possible. When it is frightened it dives deep into the depths of streams. The flesh of this dolphin is said to be as delicious as venison or turtle. In parts of Sind, Bengal and Assam, this dolphin is hunted down for its meat. Even young ones are not spared. The fat (blubber) in the skin is melted and is used for burning and other purposes.

Fortunately in most other regions of our sub-continent, the *Suis* is left unmolested and consequently there is no danger of its extermination through the agency of man, unlike in the case of many whales of the seas. It is to be hoped that this dolphin will not disappear from our rivers, for this small creature together with its larger cousins (whales) are marvellous animals that should never be allowed to vanish at the hand of man. There is still much to be learned about this wonderful animal. It is earnstly hoped that the Gangetic dolphin will receive its due share of attention in future from Indian naturalists.

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THE KEYBOARD OF THE HINDI TYPEWRITER

Dr. BRIJ MOHAN,

There was a time when it was considered impossible to make a Hindi type-writer. Two difficulties were supposed to be insurmountable: the matras of above and below and the compound letters. The following matras are made above and below the main letters:

े ै ं ँ ॅ

ु ृ ् ्र ॢ ़

If ordinary keys were to be used for these matras, they would fall, not above and below the main letters, but to their right. In that case जैसे would be typed like this: ज ै. स े; अंकुश would be written thus: अ ं क ु श Thus, the traditional form of the words would be changed. So far as we know, the Remington Company made the first Hindi typewriter. Later on, several other makes appeared in the market, like the Olivetti, Olympia etc. Even now, a majority of the writers of Hindi use the Remington model. The Remington Company got over the difficulty regarding the matras by introducing Dead Keys. The matras which are to be made above or below the letters, are typed before the main letters. Thus, for typing ले we would first type े and then ल. And the key bearing the matra े would be a dead key, so that, when we type े the roller of the typewriter would not move on. And hence, when we type ल it would fall directly below े. Later on, the company improvised the system further. It constructed the dead keys in such a way that the dead key matras would fall above or below the previous letter. Thus, in the latest model of the Remington typewriter, it is not necessary to type े before ल. We type ल first. And then, when we type, े it falls above ल already typed. Thus, one of the difficulties of Hindi type-writing was got over. This device was so very practicable that other manufacturers also adopted it immediately.

The Remington typewriter contains some of the compound letters also :

श्र द्द द्ध त्त त्र ह्म द्य .

Thus, the Remington company included those compound letters on its key-board which are used very often. Still, it left out quite a few of them. Typewirters of other makes do not contain even so many. For, they included the English punctuation marks on their models. On these typewriters, all compound letters are to be used with the *halant* sign. On such typewriters we shall have to type विद्या as विद्‌या. Thus, not only will the letters be deformed, but the tendency of people to read विद्या as विदया will also increase. Even as it is, the Urduites and Punjabis find it difficult to pronounce many Hindi words correctly. With the use of such typewriters, this difficulty is bound to increase.

Before formulating our proposals regarding the matter, we shall mention certain requisites of a Hindi typewriter which we consider essential :

1. So far as possible, the shape of the letters of Nagri should not be deformed. Even where it is absolutely necessary, as little change should be made therein as possible.

2. An attempt should be made to find a place for all compound letters on the keyboard. If it be totally impossible, we should try to include as many of them as possible.

In Hindi, compound letters are formed in several ways. Some letters are written one above the other, e.g.,

गुप्त कष्ट बच्चा

Now, a vast majority of writers write these letters, one after the other, thus :

गुप्त कष्ट बच्चा

Hence, it is not necessary to give these compound letters a place on our keyboard.

Let us consider certain other compounds :

श्र क्त त्त त्र क्र रु रू हु हृ क्ष ज्ञ

There is an alternative way of writing these letters, thus :

शृ (or श्र) क्त त्त त्र क्र रु रू हु हृ क्ष ग्य (or ज्ञ)

So, these compound letters may also not find a place on our keyboard.

But, there are some compound letters, in which the original letters are changed beyond recognition :

ट्य, ड्य, ह्य, द्म, द्य, द्ध, द्व, द्ग, द्घ, द्भ, द्द, द्र, ह्व, ह्न, ह्ल, ह्म, ट्ट, ट्ठ, ड्ड, ड्ढ, छ्र

All compounds of this type must be included in our keyboard.

3. Our typewriter should be such that the Hindi typists must have as much speed in typing as their counterparts in English. We should try to excel the speed of English typewriting ; but, if that be not possible, at least an equal speed should be attained.

4. In 1954 a Nagri script reform conference was held at Lucknow. The conference decided to incorporate all the English marks of punctuation in our script. Even otherwise, many Hindi writers have begun using them as they are very handy. We should incorporate all these signs into our keyboard.

5. We should also find a place for the numerals 0, 1,...... 9 as also the signs of the four fundamental arithmetical operations. The numerals are found in the keyboard of almost all typewriters, but the four arithmetical signs have not been given a place by any of the typewriters so far. Besides, it would be desirable to include the two small brackets and the sign of equality also in our list.

There are certain special signs which are very useful in typewriting :

❀ — /

These too might, as well, be incorporated.

6. In Nagri we write the following five letters in two different forms each :

ऋ, अ ; ण, ण ; झ, झ ; क्ष, क्ष ; ल, ल ।

The Lucknow conference has accepted only the second forms of these letters. The second form of ऋ, i.e., अ is simpler. The first form of ण is defective as, when we use its half form, it gets confused with रा. Hence the other form of the letter, i.e., ण is preferable. We cannot form half letters of झ and ल. Hence these forms are discarded. For क्ष the second form is simpler.

Our typewriter should incorporate only these approved forms of letters. We shall make an exception only in the case of झ because if we retain this form of the letter, it saves us one key, as will be seen in the sequel.

So far, three forms of the numeral ९ are prevalent :

९ ९ ९

The Lucknow conference has accepted only the last form. But we shall accept the first form ९ as it will save us one key.

7. The question of the *barahkhari* of अ has become an object of controversy. Here we shall not dilate on this point. But, this much is certain that even the philologists who call the principle of *barahkhari* of अ unscientific, concede that if we accept the principle in regard to ए and ऐ it would not be unscientific. Thus, the forms अे and अै are acceptable even to them. And we save one key by accepting these forms. So we shall adopt these forms for our keyboard.

8. In the Nagri script many of the characters have two forms : the full form and the half form. If we give only the half forms of all such characters which have a vertical line at the end, their full forms can be typed by adding the vertical line. This device has been adopted in several typewriters. For example, ज is given only in the half form : ज्‍ and we add ा to form the full ज. No doubt, we have to use two keys for

typing one letter ज according to this plan. One way out of this difficulty was that the *khari pai* could be made automatic. And whenever, we pressed the button for ज, the *khari pai* would automatically get itself typed thereafter. In case we wanted only the half form of ज we would have to use the shift key.

The Hindi Typewriter committee of the Government of India has examined the question and given its verdict against it for mechanical reasons. But we think the matter requires further probe.

The defects of the Remington typewriter

(*a*) Many of our compound letters do not find a place on their keyboard :

ह्य, ड्र, ट्ट, ट्ठ, ह्म, ड्ग, ङ्क्ष, ड्ड, ड्ढ, ड्व, ढ्व, ड्म

(*b*) The half forms of these letters are not given therein :

ण फ ब

Hence we cannot type words of this kind on the typewriter :—

अक्षुण्ण, विषण्ण, फ्यास, शब्द, ब्याह

(*c*) The form ^ of र is not given. Hence it is difficult to type words like :

राष्ट्र, ड्रामा

This can be done only by using the keys for *halant* and ͵ . Then too the words will not come off satisfactorily.

(*d*) There are no punctuation marks except the *pai*. There are no Arithmetical signs : there are no special signs like the asterisk and the solidus. There is no right-hand dot. So, we cannot type the letter ङ thereon.

The proposed keyboard of the Government of India.

Recently, the typewriter committee of the Government of India has published its report. They have adumbrated a

new principle therein : the principle of half movement. Certain characters of the Nagri script occupy only half as much horizontal space as other letters : e.g., the half letters and the matras of इ and ई. But, on the Remington keyboard, the keys of such characters also produce the full movement. As a consequence, more space is left between certain words than in others. Suppose we have to write :

राम की बच्ची खेल रही है।

On the Remington typewriter, this sentence will be typed like this :

राम की बच्ची खेल रही है।

A greater amount of space will be left over between की and बच्ची than between राम and की. In the same way, a greater space will be left over between बच्ची and खेल. There will be less space between खेल and रही and again greater space between रही and है. The cause is that the matra ी does not consume as much horizontal space as the letters म and ल.

Besides, some space will be left over between च and ची of बच्ची which will appear ugly.

The keyboard of the Government has removed this defect by giving half movement to such keys. Moreover, their keyboard provides for only the half forms of certain letters. They have released several keys in this way and accomodated the punctuation marks and the Arithmetical signs in their places. Thus, they have improved the keyboard to some extent.

The defects of the keyboard of the Government of India.

(1) They have not given any compound letters. Hence all such letters have to be typed with the *halant* sign. Thus, these letters lose all their beauty. Besides, after sometime people will be habituated to drop the *halant* sign and write the corresponding letters without them. Even today, many writers do not use the sign at the end of words like पश्चात्

and अर्थात्. In the same way, after the lapse of time, we shall come across words typed like this :

अद्‌भुत द्‌वार लट्टू

When people will type and write these words wrongly, they will naturally begin to pronounce them wrongly. Even otherwise, the principle of writing all compound letters with the *halant* sign will never be acceptable to the Hindi world.

(2) The keyboard does not provide for the half forms of these letters :

ख ग घ फ थ भ

Hence we cannot type words like ख्याति, भाग्य, कृतघ्न, पथ्य, फ्यास, सभ्य on their keyboard, except with the aid of the *halant* sign. We drew the attention of the expert committee on the Hindi Typewriter keyboard, Government of India, to the matter. They wrote back, under date 20th June, 1960, that 'the frequency of the half forms of the above letters was less than that of their full forms. If our proposal was accepted, it would lessen the speed of typewriting by about 3%. The primary requisite of a typewriter was the maximum possible speed. And so, our proposal was not acceptable'.

We have read in elementary text-books of typewriting that the basic concept of typewriting is correctness of the matter and not the speed thereof. But the Government wants to increase the speed at the cost of correctness.

(3) They have changed the form of the matra of इ. The new form has not been accepted by the Hindi world. Consequently, the Lucknow Conference of 1957 has cancelled this reform and given the matra its old form.

Our proposal

These days we have 46 keys on almost all typewriters. And each key contains two signs. Thus we can accomodate 92 signs on our keyboard. We classify these 92 signs as follows :

(*a*) Full movement keys.

(i) The following vowels

अ इ उ ऋ =4

(ii) The following consonants

छ ट ड ढ द र व =7

(iii) The following compound letters

ङ्क ट्ट ठ्ठ ड्ड ड्ढ द्द द्ध द्भ द्म द्व द्र द्ध द्ब द्य =14

(iv) The following Arithmetical signs

० १ २ ३ ४ ५ ६ ७ ८ + − × ÷ = / ( ) % =18

(v) The following special signs

् (Halant), : (colon), ु (Matra of उ)

? (Question mark), — (Bottom line for underlining),

❀ (Asterisk), । (Pai), " (Inverted comma), ' (Single inverted comma)

य (The form of य found in words like काट्य, ग्राह्य) =10

Total 53

(*b*) Half movement keys.

(i) Half letters etc.

क ख ग घ च ज झ ण त थ ध न प फ ब भ म य ल श ष स ह (= ह्) ्र (form of र) =24

(ii) The following matras 3

ा ि ी

(iii) Special signs

. (Right-hand dot) , (Comma) 2

Total 29

(*c*) Dead keys : The following matras

ॅ ँ ं ं ॆ ृ ॄ ॆ . (bottom dot) ॅ =10

Summary :	Full movement keys	53
	Half movement keys	29
	Dead keys	10
	Grand Total	92

Explanatory notes

1. Our keyboard does not contain the following letters

क फ झ ह ठ ऊ ो ौ

But we can construct these letters like this :

The third sign under full movement keys is ऽ. Now, consider the following pairs of signs :—

व + ऽ = क
प + ऽ = फ, अर्थात ८ + ा + ८ = फ
भ + ऽ = झ
ह + ऽ = ह
ट + ऽ = ठ
उ + ऽ = ऊ
र + ऽ = रु

The last of these signs can also be written like this रु :

We have allotted a key to the full व. But we may also write it thus :

ō + ा

Even the first of these signs is unnecessary as we could use the zero sign for the purpose. But in that case, our क would be written like this

ō + ा + ऽ

So we shall have to use three use for the letter क. And क is the most frequent of all the characters of the Nagri alphabet. Hence by the above device the speed on our typewriter would be appreciably reduced. So we have allocated a separate key for the full व. Still, if the proposal of the automatic *khari pai* could be made workable, the key for the full व could be released and we could accomodate one more sign on our keyboard.

We have not allocated any key to the full ह. The reason will be obvious from the above list of pairs of signs. The sign ह can also be used for the following combinations

ह + व = हव (ह्व)
ह + न = हन (ह्न)
ह + ल = हल (ह्ल)
ह + य = हय (ह्य)
ह + ृ = हृ (हृ)
ह + ण = हण (ह्ण)
ह + ् = ह् (ह्)

This proposal is not an innovation. Many of our modern presses keep this form of ह which is used for ह्.

There will be no difficulty regarding the matras of ो and ौ, for

े + ा = ो
ै + ा = ौ

2. The last among the full movement keys is ‍्य. This sign will be used for writing words like

काठ्य जाड्य बाह्य

We have given another way for writing the last word above. But, of the two, the latter form is the better.

3. If the conservative forms of the letters त्त and ज्ञ be insisted upon, they could be incorporated in the keyboard and the % and ′ signs could be dropped.

4. The colon occurs among the full movement signs. The same could be used for typing the *visarg*.

5. The zero sign can serve several purposes. It may be used for the half form of व. Also, the same could be used as an indicative of abbreviation, e.g., we write प० for पंडित.

The minus sign given under Arithmetical symbols could also be used as a hyphen.

6. The solidus sign is used in fraction. But it may also be used for cancelling matter wrongly typed. The same thing could also be done with the *pai* sign.

7. The right-hand dot given under half movement signs is a multi-purpose dot. It can be used for converting ड into ड़; it may be used as a decimal sign. Also, we may use it for making the semi-colon sign by putting it over the comma.

8. The bottom dot given under dead keys may be used for several purposes thus :

ड + ़ = ड़
ढ + ़ = ढ़
ज + ़ = ज़
फ + ़ = फ़
क + ़ = क़
ख + ़ = ख़
ग + ़ = ग़
भ्क + ़ = भ्क़
। + ़ = !

9. The sign ॎ occurs among the matra signs. This too has several uses :

इ + ॎ = ई
ट + ॎ = ट़

10. The sign ‸ may be used for ₹ as well as the carat sign.

11. A cogent objection to our keyboard will be that we have to use two keys for making क which is the most frequent of all the characters of the Nagri alphabet. As an alternative we suggest that, among the full movement keys, व may be replaced by क. व can be constructed with the zero sign and *khari pai*, thus :

० + ा = व

as we have already indicated above. And व is not used very much. Hence this suggestion will not mar the speed of typing.

In this article, we have only considered the character of the signs to be accomodated on the keyboard. As to how the signs are to be arranged on the four lines of the keyboard, what particular position the different signs are to be allotted on the same line, what the sizes of the different signs are to be etc., these matters are to be decided by mechanics and technicians. Three considerations will determine these points :—

(i) Frequency
(ii) Propitiousness
(iii) Alignment.

We shall not go into the details of these things. We think in our keyboard we have incorporated all the characteristics that we narrated in the beginning of this article.

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THE PARTICULATE NATURE OF THE PHYSICAL UNIVERSE

S. R. MOHANTY AND T. S. B. NARSARAJU

That all matter, solid, liquid and gaseous, is not continuous but consists of very minute discrete particles, now called atoms, had been realized by ancient Indian and Greek philosophers some three thousand years back. It was not until the nineteenth century, however, that the work of the chemist transformed the atom from a somewhat vague philosophical idea to a material reality, whilst the discoveries of the physicist laid the foundation for the development, during recent years, of a remarkable body of detailed knowledge concerning its internal structure.

Credit for originating the modern atomic theory is usually given to the English school teacher John Dalton. His "New System of Chemical Philosophy" published in 1808 contained the germ of the theory in the following words: "All bodies of sensible magnitude are constituted of a vast number of extremely small particles, or atoms, of matter bound together by a force of attraction". The atom is the smallest conceivable particle of an element as well as the smallest portion that can take part in chemical combination. The molecule, on the other hand, is formed from two or more atoms of the same kind or of different kinds.

From Dalton's times, the atomic hypothesis has played an increasingly important role in science, first in chemistry and later in physics. It is true that at the time the theory was propounded, a few scientists doubted the existence of atoms. But today, the arguments in favour of the atomic structure of matter are so numerous and convincing that the concept is universally accepted as an established fact rather than as a theory.

Simultaneous with the development of the atomic concept, another important principle was undergoing refinement. In contemplating the constitution of the universe, Empedocles in the fifth century B.C. entertained the idea, much similar to that of the ancient Indian philosophers, that all matter was composed of the four "elements" fire, earth, air and water. This four-element theory had the influential support of the Greek Master, Aristotle, and therefore, inspite of considerable vagueness concerning its actual implications, was accepted widely for more than two thousand years. Incidentally, the idea that the four "elements" were really in the nature of principles or representations of physical attributes (hot, cold, dry and moist), and that the difference between materials was due to variation in these primal qualities, stimulated the ancient alchemists in their efforts to change base metals into gold, efforts which were unfruitful but which laid the foundation of modern experimental chemistry.

The first blow to the four element theory was given in the seventeenth century by Robert Boyle. In his book entitled "The Sceptical Chemist" published in 1661, he rejected the idea of the four principles, and laid the germ of the present-day concept of an element. The establishment of this concept on a firm foundation, however, was due to the French chemist Lavoisier in 1789. An element was regarded as a substance containing as far as was known only one kind of matter, and which could not be split up in any known way into anything simpler. It is known at the present time that there are ninety-four different elements existing on the earth while nine more have been obtained by other means. When two or more elements combine with one another by the process referred to as chemical combination the resulting product is a compound.

The masses of different atoms are different. The actual atoms are, of course, much too small to be definitely weighed, and therefore, it is convenient to express their weights relative to that of a specified atom.

In 1816, soon after Dalton had put forward his atomic theory, and when few atomic weights were yet known and those only approximately, the English physician William Prout thought it possible that all atomic weights were integral, that is, whole numbers without fractions. All atomic weights, he considered, might thus be multiples of that of hydrogen. Prout even went a step further in identifying in hydrogen the protyle (or the prime matter) of the ancient Greek philosophers. The hypothesis fell into disfavour when definite fractional atomic weights, such as those of chlorine and copper, were obtained. The researches of especially F.W. Aston of England during the second decade of the present century showed that Prout's hypothesis, in a modified form though, is of real significance.

The next development in the understanding of the nature of matter was through classification of the elements, first attempted as far back as 1829 by Dobereiner, and which culminated in 1869 in what is called the Periodic Table of the elements of the Russian chemist Mandelyeev. In such a Table, the elements are arranged in the order of their increasing atomic weights when it is found that the physical and chemical properties of the elements repeat themselves at regular intervals. It was shown by Moseley in 1913, however, that in this classification it is not the atomic weight which is of fundamental importance but the very sequence in which the elements follow one another, or for an element its ordinal atomic number.

Further light on the problem of atomic architecture was thrown from two fields apparently unconnected with each other and with the problem in hand ; they were conduction of electricity through rarefied gases and radioactivity.

The ease with which the electric current is carried varies from substance to substance. Air and other gases under ordinary conditions are very poor conductors of electricity. But at low pressures and in large electrical fields, gases become electrically conducting accompanied by a number of luminous effects through what is called a discharge, an example of which

on a grand scale is the lightning. The nature of the particles in the discharge was investigated, in the main, by the English physicist J. J. Thomson during the last decade of the nineteenth century. It was observed by Townsend and Thomson in 1897 that whatever be the nature of the gas, there were obtained particles charged electrically negative, named electrons. The charge or the amount of electricity on the electron, determined by the American physicist R. A. Millikan, is the absolute minimum of charge, and all other larger amounts of electricity are simple multiples of this, or in other words, the electron is the atom of electricity. The mass of the electron is negligible, being about one 1837th of that of the hydrogen atom. The electrons come out of the atoms and molecules which are consequently left oppositely positively charged. These positive residues were investigated first by Thomson and later and more fruitfully by his countryman Aston, and by A. J. Dempster in the United States.

While the nature of the particles produced in gas discharges was being studied, it was observed in 1896 by Henri Becquerel of France that certain elements like uranium give out spontaneously, of their own accord and without the aid of any external agency, radiations which like ordinary light rays affect the photographic plate and like x-rays cause ionisation in gases, that is, knock out electrons from neutral particles. Such elements are said to be radioactive. The nature of these radioactive emanations was investigated by the Curies, Pierre and his wife Marie of France, and by E. Rutherford, F. Soddy and W. Ramsay of England. It was found that the emanations consist of three parts : (i) the alpha-particles which are helium atoms devoid of two electrons each and therefore, doubly positively charged ; (ii) beta-particles which are high velocity electrons ; and (iii) gamma-rays, very similar to ordinary light rays, but of high energy and invisible. To account for the ejection of material particles from atoms of radioelements, Rutherford and Soddy proposed in 1903 the revolutionary theory that these atoms are unstable and undergo spontaneous disintegration

or break-up with the emission of the alpha- or beta-particles and the formation of atoms of new elements quite different physically and chemically from the parents. Thus, the age old Daltonian principle of the indivisibility of the atom (the very term 'atom' connotes indivisibility) is no longer strictly valid.

By 1911, the number of radioelements had risen to forty. Only twelve positions were available in the periodic table, on the other hand, for their accommodation. The problem was : How can forty elements be fitted into twelve places ? The solution was supplied in 1913 by K. Fajans and by Soddy in the group displacement law according to which a radioactive element changes its position in the table consequent to the emission of an alpha- or (/and) a beta-particle. This led to the recognition of isotopes, elements chemically identical but of different masses, and isobares which are different elements with the same atomic weight. That non-radioactive elements as well exist in different isotopic forms was first observed in the case of lead, and extended to other elements by Thomson, Aston and Dempster during the years 1912-20 through the examination of positive particles in the discharge. These investigations led Aston to formulate the whole number rule which is essentially a modified form of Prout's hypothesis. According to this rule, all atomic masses are very close to integers ; the fractional atomic masses determined chemically are due to the fact that the elements are mixtures of isotopes each of which has an approximately whole number atomic mass.

Soon after the discovery of the alpha-particles, they were used as probes to explore the interior of the atom. This was done by exposing thin metal foils to these particles when it was found that whilst most of them suffer no appreciable deflection, a small proportion are scattered out of their original courses. These observations led Rutherford in 1911 to put forward the nuclear theory of the atom according to which the atom consists of a nucleus or core and a number of electrons revolving round

the nucleus not unlike the planets around the sun in the solar system. The nucleus is charged positively, the number of such charges being equal to the atomic number and also to the number of planetary electrons. The mass of an atom is concentrated in the nuclues.

In the infancy of the nuclear atom, it was supposed that the nucleus was made up of protons and electrons. The number of protons was sufficient to make up the mass of the nucleus. The intranuclear (or the so called cementing) electrons were responsible for holding the otherwise mutually repelling positive units into a compact mass. They neutralized the charge of some of the protons and made the total positive charge equal to the actual charge of the particular nucleus. An inherent contradiction arose, however, from the inclusion of electrons within the nucleus. An atomic body—electron, nucleus and the particles that make up the nucleus—spins like a top around its own axis. The measured spin of a nucleus is independent of the number of electrons supposed to be in it. The same is also true of nuclear statistics. (By the statistics of a particle is meant that property which determines the behaviour of an assemblage of particles of a specified kind when they interact or are in close physical proximity). The way out of these difficulties was achieved through the picture of the nucleus presented by the German physicist W. Heisenberg in 1932 consequent to the discovery by James Chadwick in the same year of the neutron, a particle having the same mass as that of the proton but no charge. The theory was modified and improved upon in 1933 by the Italian E. Majorana. In the Heisenberg—Majorana model, the nucleus contained protons responsible for all the charge and a part of the mass, and a certain number of neutrons which contributed the rest of the mass. The protons and the neutrons in the nucleus (or as they are now often termed, the nucleons) were held together by wave mechanical exchange forces brought into existence through spontaneous charge transfer and consequent change of identity of the particles from proton to neutron and *vice versa.*

Thus, in 1932 our picture of the physical universe appeared to be remarkably simple. The whole material world was thought of as made up of just three elementary particles, namely the proton, the electron and the neutron. By suitable arrangements of these three basic building materials, one built up the atoms of the chemical elements ; and from suitable arrangements of the latter, all the multitudes of other substances of which the universe is composed. Further, under the quantum mechanics theory energy, like matter, was also made up of tiny discrete units ; the only two other physical entities found in nature, namely light (or in more general terms electromagnetic radiation) and gravitation contributed, therefore, two additional elementary particles—the photon, the unit of electromagnetic radiation, and the graviton, the unit of gravitational energy. Since the appearance of the photon and the graviton is conditioned by some rearrangement of electrons, protons and neutrons, it appeared that the latter three particles could be considered the basis of all physical phenomena, the irreducible units of matter sought after by scientists since Democritus. The illusion was, however, short lived for in the same year, that is 1932, C. D. Anderson at the California Institute of Technology discovered a fourth elementary particle, the positron, similar in mass to the electron but with a positive charge ; the possible existence of such a particle had been predicted in 1930 on theoretical grounds by the English mathematical physicist P.A.M. Dirac. Incidentally, the conversion of a high-energy photon on interaction with atomic nuclei into an electron-positron pair is a fine demonstration of the Einstein principle of the equivalence of mass and energy.

Since the electron is not a constituent of the nucleus, the beta-ray electron from natural radioactive nuclei must result from the spontaneous conversion of a neutron into a proton and an electron. Similarly, the beta-ray positron from some artificial radioactive atoms is created in the transformation of a proton into a neutron. Thus, it has to be admitted that whilst the elementary particles are not composite, and as long as they exist they are immutable with absolutely

constant properties, nevertheless there are occasions when one or more such particles can disappear altogether with the simultaneous creation of another set. According to the laws of quantum mechanics, all beta-particles, whether electrons or positrons, should be discharged from nuclei only with certain well defined energy. The measured energies range, on the contrary, over the whole continuous spectrum from zero to the maximum possible value. This was indeed a strange phenomenon. If the quantum theory was correct, it seemed to violate one of the fundamental laws of nature, the principle of conservation of energy. There were also difficulties regarding the conservation of angular momentum and statistical properties. It was Wolfgang Pauli who in 1931 suggested the solution that when a beta-emitting nucleus erupts, it creates not only a beta-particle but another particle, the neutrino, with mass negligible compared to that of the electron and no charge. The neutrino hypothesis saved the conservation principles at one full swoop. It, however, added a fifth particle to confuse the picture. But this was only the beginning. More were soon to follow.

The view that the nucleons were held together by wave mechanical resonance forces brought into existence through charge transfer in the form of the electron or the positron was not in harmony with the short range nature of nuclear forces. This difficulty was sought to be removed by the Japanese physicist Hideki Yukawa in 1935 through the postulation of the existence of a new charged and unstable particle as the basis of exchange between a proton and a neutron. The mass of this hypothetical particle was calculated to be about 140 times the mass of the electron (we know today that 300 is a better figure), and its mean life to be about one millionth of a second. Such particles with masses lying between those of the electron and the proton are now called mesons. These were thought of as the nuclear glue binding together the neutron and the proton in the nucleus. Since there were three types of equally strong bonds in the nucleus (neutron-proton, proton-proton and neutron-neutron), it was assumed that there would be

three kinds of mesons, namely positive, negative and neutral. Within two years after Yukawa made his proposal, investigators in the United States actually discovered mesons with masses about 200 times the mass of the electron. The discoverers, Carl Anderson and Seth Neddermeyer at Caltech, and J. C. Street and E. C. Stevenson at Harvard, found the particles in the atomic debris produced by cosmic rays reaching us from upper space.

Around the year 1900 it had become known, especially through the researches of C. T. R. Wilson in England and of J. Elster and H. Geitel in Germany, that the charge on a carefully insulated electroscope leaked continuously due to ionization of the air in the electroscope even when precautions were taken to prevent access of known ionizing radiations. It was believed for about a decade that this mysterious ionization was due to radiations from radioactive substances present in the earth's crust. T. Wulf of France initiated in 1909 observations on the discharge of electroscopes at elevated places. In 1910 the Swiss scientist A. Gockel studied the same phenomenon in the course of balloon ascents. In the succeeding years, more careful quantitative measurements were reported by V. F. Hess in Austria in 1911 to 1913, and by W. Kolhorster in Germany in 1913 and 1914 ; both these investigators made balloon ascents to heights about 16,500 and 30,000 feet respectively and found at high elevations a marked increase in the ionizing radiations. It was concluded, therefore, that the radiations were extraterrestrial in origin, and since they reach the earth's surface after passing through the atmosphere, must have great penetrating power. After the first World War, the study of these highly penetrating radiations was resumed in 1922 particularly by Millikan and his collaborators. They used unmanned balloons containing recording instruments, and were thus able to obtain measurements at altitudes of 51,000 feet. Observations were also made on mountain tops as well as at considerable depths in the water of lakes. The existence of the penetrating radiations was confirmed, and it was Millikan who in 1925 christened them cosmic rays.

All the early work on cosmic rays concerned itself with the total amount of ionization produced by the rays, and for this purpose some form of ionization chamber plus a suitable electrometer were enough. The great discoveries in the field of cosmic ray phenomena were, however, made possible through the judicious use of the Wilson cloud chamber, the Geiger-Mũller tube and the photographic plate, each capable of isolating individual particles.

It was soon revealed that the radiations are heterogeneous in nature, and subdivisible into a highly penetrating hard component and a less penetrating soft component. At ground level, the total radiations consist of positrons, electrons, protons, mesons, neutrons and photons. These are almost all secondary particles; the nature of the primary radiations incident upon the earth's atmosphere is not completely understood. The primary radiations are of high energy, far greater than that of any fundamental particle previously known. It is thought to consist mainly of high energy protons though nuclei heavier than hydrogen have been observed.

The mass of the meson discovered by Anderson and Neddermeyer, and Street and Stevenson, in 1936 was about 200. Studies of the properties of mesons extended over a period of ten years revealed that whilst mesons were produced with ease and in great numbers by the incoming cosmic radiations in the upper atmosphere, only rarely were they later absorbed by atomic nuclei. This discrepancy contradicted not only the Yukawa meson theory but also the general principle of the reversibility of microscopic processes. In seeking for a way out of the dilemma, Robert E. Marshak of the United States suggested in 1947 that there were really two types of mesons: (1) a heavier variety which possessed the properties postulated by Yukawa and which was responsible for the nuclear forces, and (2) a lighter variety into which the heavier one decayed. It was the latter type, he proposed, that cosmic ray experimentalists had been observing for ten years. Before a few weeks were out, C.F. Powell, G. P. S. Occhialini and their collaborators

in England observed the heavier mesons at high altitudes in the Bolivian Andes. It has since been shown that whilst the heavier mesons interact strongly with protons and neutrons, the lighter ones do not. The heavy particles are called *pi*-mesons and the lighter variety the *mu*-mesons.

The *pi*-meson exists in three forms, namely, positive, negative and neutral. Only two forms of the *mu*-meson, positive and negative, have been found ; it would be very difficult in any case to detect a neutral *mu*-meson. The mass of the charged species of the *pi*-meson is 273, and that of the charged *mu*-mesons 207. The neutral *pi*-meson is a little (9 electron masses) lighter than the charged *pi*. It is of significance for the meson field theory of nuclear forces that the *pi*-mesons, in common with the field quanta on which electrical and gravitational forces are based, obey the statistics of S. N. Bose and A. Einstein. The mesons *pi* and *mu* undergo spontaneous disintegration. A positive or negative *pi*-meson decays into a positive or negative *mu*-meson and a neutrino within about one 250-millionths of a second. Then, the positive or negative *mu*-meson decays into a positive or negative electron plus two neutrinos within about two-millionths of a second. The neutral *pi*-meson also is unstable and decays into two gamma-ray photons in a very very short time.

The K-mesons are particles with mass intermediate between that of the *pi*-meson and that of the proton. This class consists of two *tau*-mesons (charged positive and negative), one (neutral) *theta*-meson, two K-*mu*-mesons (charged positive), two K-*pi*-mesons (also charged positive), one K-positron-meson and one (negative) K-meson.

The discovery of the hyperons, particles with mass intermediate between that of the proton and that of the deuteron, makes the picture of the particular world more confusing. There are three *sigma*-particles (positive, negative and neutral), one (neutral) *lambda*-particle and one *xi*-particle (charged negative). Thus, by to-day, the number of elementary particles including

the antineutrino, the antiproton and the antineutron is 30. And, if 30 elementary particles really exist, why not many more ?

This is indeed far from the simple picture of the physical universe which seemed possible in 1932. The plethora of elementary particles apart, the fact that many change from one type to another is extremely disconcerting. Is nature really so complex ? Or, is there some unifying principle, such as, for example, mass quantization ? Attempts to answer these questions have been made by Fermi and C.N. Yang, and by G. Wentzel of Chicago, but without any appreciable success. The field is still open, and there awaits a crown for him who elucidates the nature of the elementary particles and their role in the make up of the physical universe.

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ROCK MAGNETISM AND HYPOTHESIS OF CONTINENTAL DRIFT

ASHOK KUMAR GHOSH

Rock Magnetism :—

The subject of 'Rock Magnetism' is interesting and has a old history. Our knowledge of magnetism bears its origin to the discovery of 'Lodestone' or natural mass of magnetite (Fe_3O_4) during the ancient times, which showed well developed polarities. But the subject of magnetism was developed almost independently of this initial phenomenon and much stress was laid on the magnetism of metallic substances only. Little or no attention was paid to those naturally magnetized bodies which are distributed over a large part of the earth's surface, until recently, when the magnetic method became an important part of Geophysical Exploration for ore bodies and various geological structures of economic importance.

The magnetic properties of rocks, look so complex and heterogenous, that a systematic study of these, based on the physics of the magnetic materials becomes quite difficult. Furthermore, as the study of 'Rock Magnetism' advances in details, it is experienced that due to the lack of thorough information on the magnetic properties of metallic oxides and various other compounds of metals and non-metals, the task becomes a complicated one.

The major part of the Earth's magnetic field is due to causes within the Earth itself, which are mainly due to the 'Magnetic masses' in the Earth, and 'Electric currents' in the Earth producing a magnetic field around the Earth by induction. Extensive study and measurement of the Earth's magnetism have been carried out in various parts of the world. Through the application of the potential theory to the Earth's observed

field, some investigators have separated this field into the three components :—

(i) The Internal field responsible for as much as 94% of the total magnetization of the earth ;

(ii) The External field believed to be due to the circulation of electric currents in the ionosphere accounts for only about 3% of the Earth's magnetism. (Runcorn, however, does not agree to the existance of an external field like this) ;

(iii) The Non-potential field is supposed to represent a non-potential' contribution to the earth's field ; that must be explained by assuming the flow of electric currents from the earth into the air and vice verse across the surface, and accounts for the rest of the Earth's magnetism (about 3 percent). The separation has been made on the basis of Spherical Harmonic Analysis of the observed field of the magnetic Earth.

The Earth's crust is composed of three types of rocks namely the Igneous, Sedimentary and Metamorphic rocks. Rocks can acquire magnetization in several ways which may-vary with the method of formation of the rock and with its subsequent history. The composition of the rock also has much to do with the process. It may, at the first sight, appear that the magnetic properties of rocks is chiefly dependent upon the proportion of its iron content, but actually it depends on the valency of the iron present as we know that trivalent iron is more magnetic than bivalent iron. Hence it may be said, in other words, that the magnetite (Fe_3O_4) content of a rock chiefly determines its magnetic characteristics.

Igneous rocks, and some of the Metamorphic rocks, which have cooled from a high temperature, are magnetized as they cool through their respective Curie points in the presence of the magnetic field of the earth, and their intensity is proportional to the ambient field. This is called the Therme-Remanent Magnetisation (TRM) or simply as the Thermal Magnetization.

This type of magnetization is quite stable and may provide a reliable indication of the direction of earth's magnetic field at the time of formation of the rock, provided no physical or chemical changes have taken place since its formation.

The magnetization acquired at some constant range of temperature is generally known as the Isothermal Remanent Magnetization. But this is prominent in these cases where a strong magnetic field appears, for a short duration, as in the case of lightning.

Most of the sedimentary rocks acquire their magnetization while they undergo hardening through compression and possible heating and suffer Physical and Chemical changes also at the same time. The same happens to some of the Metamorphic rocks also.

Some of the sedimentary rocks evidently acquire their magnetization from the magnetic orientation of the 'iron-oxide' grains in the presence of the earth's magnetic field. These 'iron-oxide' grains derived from some originally magnetized igneous rocks retain some of their originally acquired magnetization. The most common example of such magnetization of Sedimentary rocks are the varved clays of New England (U.S.A.) and some other glacial lake deposits of Sweden.

Since the beginning of the twentieth century, the attention of investigators on the Magnetic field of the earth has been arrested by the possibilities of 'Rock Magnetism', and Johnson Murphy and Torreson (1948) of the Department of Terrestrial Magnetism, Carnegie Institution (Washington), showed for the first time that it was possible to trace back the history of the magnetic field of the earth far beyond the historic times by the measurements of the weak magnetization possessed by certain sedimentary rocks' Prior to Lynton's invention in 1937, it was thought that the sedimentary rocks do not have a remanent or residual magnetism.

There are a number of important application of Rock Magnetism to the controversial problems like the Continental Drift and Polar Wandering, which depend on the determina-

tion of the direction of the earth's magnetic field during the past. In recent years, such determinations, concerned with the directions of the earth's field at various geological periods is known as 'Palaeo-magnetism'. This represents the resultant of the current magnetization and the residual magnetization from amuch different field existing during the formation of the rock under observation.

Now the effective application of Rock Magnetism depends on the clear recognition of the following two points, viz.:

(i) The ferromagnetic materials in the rock formations may have varying degrees of magnetic characteristics and the extent to which they have acquired Isothermal Remanent Magnetization by their long exposure to the present magnetic field of the earth, even at ordinary temperatures, depends upon the chemical composition and the shape and size of the grains, as pointed out by Ne'el (1955);

(ii) It has been found that the magnetic polarixation of rocks in various places, differs in direction thoughout the geological times, (Runcorn 1955), and the present field is a fluctuation of comparatively short time-scale of the field present during the Tertiary periods.

Hypothesis of Continentak Drift :

The idea that the continental masses, sialic in nature, float about on a denser substratum called sima, and drifts over it has been supported by many a workers on this problem. It was Francis Bacon, who apparently suggested for the first time that continental drift had occurred. The basis of his observation was the similarity of the Eastern coast line of South America and the Western coast line of South Africa.

But the credit of going the first thorough discussion of the Hypothesis of Continental Drift goes to Wegener in the 1920's. He suggested that initially all the continents were a single sialic mass forming the uppermost layer of the crust and were

floating over a simatic substratum, and later on this was separated into different continental blocks by the influence of the rotational and gravitational forces of the earth.

This became the subject of discussion among the leading geologists and geophysicists. But later, due to the lack of adequate and conclusive evidences and reasons in favour of the hypothesis, its importance have been discounted. Also Darwin's famous paper on Polar Wandering was published by that time, which ruled out such a possibility. Jeffreys and others, on the basis of the inferences successfully drawn by geophysicists on the strength of the earth's interior showed that the suggested explanations of Continental Drift were not standing, although Wegener made a strong case in its favour. Afterwards, Du Toit and many other celebrated geologists collected a large volume of information from structural geology and palaeontology, which in the words of Runcorn, a celebrated worker on Rock Magnetism 'by its nature, could hardly appear decisive to the scientists in other fields and which perhaps unintentionally obscures some of the simpler and very persuasive reasons for serious consideration of continental drift. Moreover, these arguments are specially qualitative, and their various presuppositions are open to criticism. They were therefore, perhaps unfortunately, not widely considered'.

Now let us see what the 'Rock-Magnetism' has to do with the controversial problem of continental drift. Many items of useful information about the movement of land masses relative to the geographical poles can be obtained from the declination and inclination of the magnetism of a rock specimen, without knowing whether rocks possessing reversed magnetization are due to 'self-reversal' or due to the reversal of the earth's magnetic field. If L be the latitude and I the mean dip. then the relation $2 \tan L = \tan I$ gives the value of dip at the place of observation.

To work out the above problem, the only assumption needed is that, averaged over periods of time, say 10,000 years more, the declination at any place is zero, and, the inclination agrees with that for the field produced by a central dipole parallel to the geographical axis. This is equivalent to the

assumption that on the average, the magnetic axis of the earth is colinear with its rotational axis. This is very plausible, since almost any possible thory of the earth's field relates the origin of the dipole field to processes governed by the rotation of the earth. On the other hand, the secular vaiation of the declination and inclination is almost certainly the result of hydrodynamic disturbances probably consisting of eddies in the outer part of the core, and may be expected to average out over a long period of time to give the mean dipole field.

Extensive study of the magnetism of sedimentary rocks ranging from Cambrian to Eocene has been made in England by Creer, Irving and others. In India, detailed work on the Palaeomagnetic characteristics of the Rajmahal and Deccan traps have been made by Singh, Clegg, Radhakrishnamurty, Sahasrabudhe, Deutsch and others.

Irving's work suggests that in the Pre-cambrian itmes, England may have then been oriented some 100° West of North. Exactly at what age after the Trias, England rotated clockwise from 34° West to the value of 14° West found by Hospers for the Irish Eocene lavas is not yet known. Clegg's work on the Triassic rocks, and Irving's study of the Pre-Cambrian Torridonian rocks of Scotland indicate large land movements. There is a big discrepency between the inclination of the Old Red Sandstone as measured by Creer and by Stubbs, which is under investigation. But for detailed study of the process, more attention is to be paid to the magnetic sedimantary rocks of Jurassic and Cretaceous age. Unfortunately, many of these many of these rocks (e.g. Cretaceous chalks and limestones) are either very weakly magnetic or unstable magnetically, to permit any investigation.

From the above findings one would take that England has rotated clockwise some 34° in the last 150 million years. One is immediately faced with the question as to whether this rotation has been shared by all or part of the ontinent of Europe. This can be answered only when the awaited results of the systematic studies of Palaeomagnetism of continental rocks are out. Work on the Spanish and French Trias is under progress.

In India, of special interest is the wide srpead glaciation some 200 million years ago, with ice flowing north Detailed study of the Palaeomagnetism of Rajmahal and Deccan traps were made in order to ascertain some concrete information regarding the hypothesis. Samples were collected from Rajmahal traps of Eastern Bihar. These lavas which consist mainly of Basaltic and Pitchstone trap flows overlie the Upper Gondwana Shales and Sandstones. They are most probably Jurassic in age, and according to Hobson, they represent the earliest part of the volcanic activity, that afterwards, during the Cretaceous and early Eocene periods gave rise to the Deccan traps.

The observations indicate that the Rajmahal traps possess a steep upward dip (magnetic) to the order of-64°, which is not consistent with the assumption that the Indian land mass occupied a position South of the equator, about 50° to 60° during the formation of these rocks. The combined results of the Rajmahal and Deccan traps reveal that there has been a continuous decrease of dip which is due to the continuous northward drift of the Indian landmass, extending from the Jurassic to the Eocene. Thus the following conclusions are drawn :

(i) That there has been a Northward drift of the Indian landmass.

(ii) At the same time Anticlockwise rotation of the Indian landmass has taken place,

since the end of the Mesozoic era, when areas studied were situated as far south of the equator as 40°S.

Thus the Palaeomagnetic study of England and India reveal some concrete evidences of the large scale land movements mentioned above which goes a long way to show that the hypothesis of continental drift has a standing.

Discussion :

A large number of scientists do not accept the idea of continental drift in the recent history of the earth, beacuse no adequate theory exists for the mechanism which may be put forward to explain such a drift.

The supporters of the hypothesis of continental drift, however, attach muchimportance to the fitting of the Atlantic coast line of South Africa and South America. Jefferey observed that this fit is only a poor one but this has recently been rejected by Carey by advancing arguments of his own.

As Hill and Dibblee observe, the continental drift of thousands of miles since the late Mesozoic is in agreement with the annual rate of movement occurring along the famous San Andreas fault. From Geological correlation it appears that a displacement of about 350 miles in 100 million years, i.e. about 0.6 centimeter per year, which is well in agreement with the geodetic observation of the present time rate of about 1 centimeter per year. The existence of this relative motion in the earth's crust today imphe's that movements deeper in the crust are taking place for which we have no adequate theory. We have no means of knowing whether such movements are capable of causing relative displacement of the large continental masses.

It is just possible that Thermal convection in the mantle is taking place which may be responsible for the continental drift. It has been observed that the present distribution of continents and oceans has certain regularities. The oceans and continents are dimeterically opposite, and only 3 percent of the area of the contients has land antipodal. Prey and Vening Menisez have expressed this fact matheatically by showing that if the height or depth of the rock surface is expressed as a series of spherical harmonics, the first, third, fourth and fifth harmonics are predominent. Vening Meinsez draws the inference that the present distribution of the contients is fixed by the presence in the mantle of convection currents with a certain number of cells. One would infer that the continental rafts would be drawn towards those parts of the earth where the convection currents are falling. At first sight it appears that the dispersion of the continents occurred unusually late in the history of the earth but accepting the above argument, the dispersion of the contienents in the late Mesozoic time must

reflect a change in the convection patterns in the mantle at that time.

It has not yet been possible to suggest an acceptable explanation of the change in the convection pattern in the later part of the earth's history but according to Runcorn, may be the result of a gradually growing core, which, as its radius increased, would favour convection with a higher number of cells. It is supposed that the present concentration of land mass in the Eastern Hemisphere is the result of a 'primevil convection current consisting of a single cell which swept the continental material to one area'. Such a single cell convection pattern would, however, be set up only if the heavy iron core was then very small. The idea of a core growing through geological time, rather than one formed initially has been postulated by H. C. Urey in recent years, and may now receive support from continental drift.

The study of Palaeoclimatology indicates that there exists a great change of climate from Glacial to Warm from Permo-Carboniferous to Carboniferous. During the Permo-Carboniferous period (200 million years ago) there was a wide spread glaciation of India, South Africa, east coast of Southern South America and the South West coast of Australia. According to Holmes, such a distribution of ice sheets agrees with the assumption that the lands were grouped together round the South geographical pole. If this was the case, then, while all these countries have made big latitude shifts away from the South pole, India must have made particularly a bigger shift since it now lies well north of the equator. This fact has been verified by the various observations of the Rjmahal and Deccan Traps which has been discussed before.

While concluding, it must be mentioned that Holmes has assumed large relative movements of different land-masses while Gutenbrg has observed that there is only a shift of the crust as a rigid whole, relative to its axis of rotation. This still remains as a controversy among the supporters of the Hypothesis of Continental Drift.

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MAN-LIKE CREATURES : OUR NEAREST RELATIVES

Dr. G. N. JOHRI

Monkeys and apes make a strong impression upon us by some striking similarity between their behaviour and that of man. Don't they use their hands in the same way as we do and don't their faces show similar expressions to those of man in many states of emotion. Then how is man different from these creatures. Surely not by his tools, clothes or complex economies for these are the result of his steadily developing brain. In fact bone for bone, we are one substance with these creatures and the similarity, therefore, is natural for, whether we like it or not they are our not too distant cousins derived from a common ancestor or as Darwin pointed out, "not perhaps identical but brothers under the skin". They have shared the earth with man for thousands of years without any sympathies from him and having evolved through continual explorations and changes, they possess features which show a very high degree of that adjustibility and power to obtain sustenance from an unfavourable environment.

The largest and the most highly developed are the great Anthropoid or man-like apes placed only next to man in the animal series. They are the gorilla, chimpanzee (both African), orangutan and gibbon (both Asian). The gorilla of equatorial Africa is the largest, an average male standing about five feet and weighing over 400 lbs. The body is clumsy and heavily built with enormous shoulders and despite the tremendous power and strength, gorillas are normally peace loving nomads daily changing their rough sleeping platforms made up of branches and leaves in the trees for the mother and the young ones, the father himself remaining on guard at the base of the tree. The common sleeping posture is either on sides or back with one or both the arms under the head. The diet is strictly vegetarian consisting of fruits, leaves or roots. The gorilla's voice ranks third (the chimpanzee's first and gibbon's second) in relation

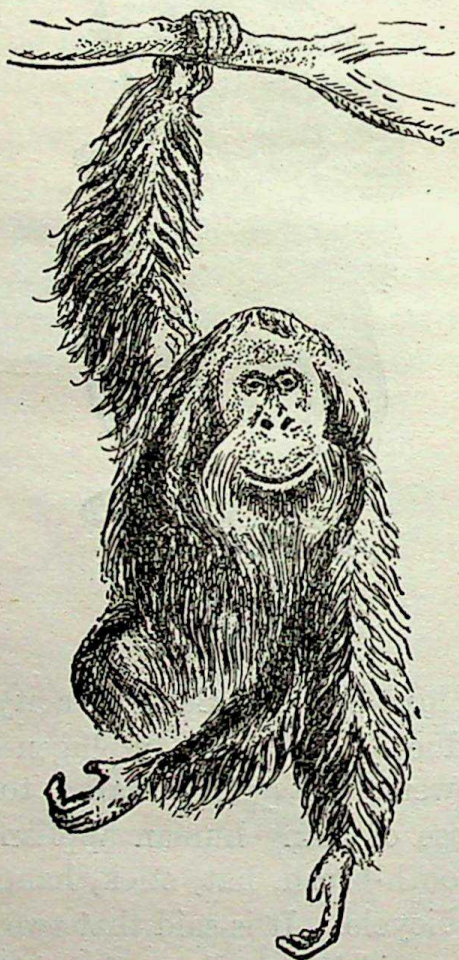
to our own. At times it may be in the form of piercing shrieks, at others a thunderous roar. Drumming the chest with clenched fists, with or without vocal accompaniment is characteristic of the males when in excitement or anger. Ordinarily no gorilla will attack human beings but if encountered, it becomes extremely ferocious and is a terror to the natives. They walk on all fours placing the back of the folded fingers and the soles of the feet on the ground. Occassionally they may stand upright as well. They are fairly skilful but mentally low. Besides, being so close to man, they also resemble him in natural fear and avoidance of deep water, inability to swim without tution or practice, hygienic care of the young, preferential use of the right hand and in leading a well knit family life. The infants are carried on the hip of the mother and the normal life span of an individual is estimated to be about 45 years.

GORILA

In striking contrast to the slow-moving, reserved gorilla is its nearly related but not so stout co-forest dweller, the playful chimpanzee. It has a shorter body nearly four feet high and about 150 lbs. in weight. Big ears stand out prominently from the sides of the head and the lips are long, mobile and protusible. It possesses the most highly organised brain which ranks almost first in intelligence. Very imitative with excellent visual memory and considerable mechanical ability, they love to play with great curiosity and have an inclination for affection. Infact they display an almost human capacity

CHIMPANZEE

for reasoning and love of fun. Such vivacity which is almost unquenchable is due to its quick intelligence with ingenuity and reasoning powers. It quickly takes to wearing clothes and even to the use of many human appliances such as knife and fork, comb, tooth-brush, hat, stick, hammer, screw driver and even riding a bicycle. It is said that two famous chimpanzees in a zoo used to raid fruit stalls on their bicycles. Chimpanzees are known to whine, moan, groan, grunt, bark, shout, yell, hoot, scream and to emit several kinds of sounds expressing different states of emotions and natural wants. This wonderful

range of its voice led investigators to a thorough study and some of them succeeded in establishing communication with them. In wild, they live in groups or bands with three or four females to a single male and are well suited to climb trees. Usually they move on all fours although upright walking can also take place. They also sleep in beds of twigs and foilage on the intersecting branches but at a greater height than that of gorilla. Unlike the male gorilla who sleeps on guard at the base of the tree, the male chimpanzee rests on the tree itself under his family's nest which forms a protecting roof. When young they are quite docile but become dangerous and aggressive as age advances.

ORANG-UTAN

The Orang-utan stands mid-way between gorilla and chimpanzee in size and strength. Heavy in build with thick neck,

long arms, short bowed legs, broad chest and prominent abdomen ; the Orang-utan is ugly or unsightly in appearance. Once found in central Asia, they are now limited to the forests of Borneo and Sumatra, where they live almost wholly on trees moving through branches by means of their long arms and hook-like hands. Moving on ground is difficult and looks like that of

GIBBON

a man bent down with age. The adult males have huge fleshy pads on either side of the face and the whole body is invested with a thick covering of reddish-brown hair. It may stand more than four feet in height and weighs about 160 lbs. Rather solitary in nature, the male lives alone or with a female accompanied by one or more offsprings. He also sleeps on his back upon the rude improvised leafy platform with his arms and

legs grasping the nearest branches within their reach while he sleeps. The diet includes fruits and leaves and drinks water by dipping the hands in it and letting the drops fall into the mouth or sucking them off the fingers. Ordinarily Orang-utan is quiet, but can be a fearful foe if molested and expresses its anger by bellowing or roaring in a deep, bass voice.

The gibbons, smallest and lowest among the man-like apes are of many varieties found in Sumatra, Malaya Peninsula, Indo-china and in upper Assam in India and they are all more or less similar to one another. They are most suited for life on trees where their progress is remarkably rapid. They use their long arms and legs with pronounced ability to swing themselves from branch to branch and so quick are the movements that they easily deceive the eye. Long distances are thus covered with greatest ease and uninterruptedly for several hours together without the slightest sign of fatigue. Moreover, it is the only man-like ape which can habitually walk erect like man with a good speed. The voice is very loud and is aided by a globular extensible pouch in the neck region in males. A typical male reaches a height of about three feet and has a neat round head, arms almost touching the ground when standing erect and covered with a dense soft wooly coat. They are gregarious living in groups of various sizes. Diet is varied and consists of fruits, leaves, insects, eggs, spiders, lizards and small birds. Gibbons are delicate creatures, quiet and gentle but at times turn rude and ill-tempered. They do not live long in captivity unless conditions are very favourable.

THE AMERICAN POETRY AND POE[1]

B. P. RAI

The earlier half of the 19th century in America is predominantly emused by the poetry of Edgar Allan Poe. He ranks too high among his contemporaries and occupies an unrivalled place in the history of American poetry. Though he lived for a short span of 40 years (1809-1849) still he exercised his uncommon intelligence in shaping the poetry to a pattern which may be aired with American colour and atmosphere. It values little whether he failed to stand equal his objective, because the language and the technique in legacy was purely dubbed in the English poetry. The literature which was available for the 19th century American poets was nothing of their own but it was borrowed from the English diction. Thus the Americanisation of the English poetry was introduced by the 18th and the 19th century poets of America. This was fully achieved in the 20th century.

Though the criticism may sound very severe : but it is by no means a disparagement to the American poetry. It is a happy wonder that even in the youth of American poetry, inspite of the fact that with English tongue as their medium and English culture as their cultural nuitriment ; this rapidly growing land has produced such definitely American poets as Edgar Allan Poe, Walt Whitman and Emily Dickinson. These important figures dates back beyond the barline of 1900 ; still it cannot be advocated that they had a definite volume of American poetry.

Near and before the period of Poe, the American poetry had such poets who were not so high in their art and technique but received inflated importance for the simple reason that in their period, not much of value was produced. These poets, for lack of rivals of immortal stature, dominated their contemporary scences ; where as Longfellow, Lowell, Bryant, Whittier etc., have been entrenched in the American Schools, although

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[1] A short note—Editor.

their work can stand scarcely any comparison with immortal poetry of the English tongue, at no matter what level the comparison might be made. In spirit it is not purely American but an outcome of English Models, Elizabethan, Victorian etc. This cultural near tregady is subject to be regretted. Longfellow exercised his powers of great imagination to air the poetry with new colour by introducing such poems as "Hiawatha" which expresses none of the actual Indian personality, out-look or culture inspite of its use of Indian names in a superficial manner. The genuine American expression sprang in rapid and spectacular development in the 20th century. And this school of poets began to excercise an influence on English poets. This phenomenon began in 1920 and had steadly become more marked.

Overfulsomeness has always been the characteristic of the American poetry ; that is, the poets of America leave a very little room to chew the amount they have taken at a time. Poe for instance in his efforts at techanical complication and innovation went to such an extreme of Onomatopoeia in the "Bells" that to-day we find it almost a mere game of words.

Keeping time, time, time
    As he knells, knells knells
In a happy runic rhyme
    To the rolling of the bells
Of the bells bells bells
    To the tolling of the bells
Of the bells bells bells
    Bells bells bells.
To the moaning and the growning of the bells.

By this solitary example I donot wish to undermine the experiments of Poe in the sphere of poetry. He was a successful poet. He poured the English poetry into the American cups which was later on modified and tempered in the American taste. Let us analyse the reasons which hurdled the great poet to bring home a pattern which may profoundly be claimed as American in style. Here it will be fully justified to recollect that Poe was working out his poetry in a period which was

dominated by the influence of science. And this great monster challanged to shoot down the luminous wings of poesy to the bare realities of the facts and the poets of England took the way to the "vernal wood" being outraged by the robbery of the industries and the cruelties of the wars. English school of poets decided to boycott the suffocation created by the industries and valued that the man is not made of man for the field of wars. Thus the imagination of the sky came down to the earth where studies were promoted in the direction of humanity: the object of proper study for man is man. This influence was crystallised by Poe in—

"Science? True daughter of old time"
Who alterest all things with peering
eyes", and further it was coveted
as to "Why preyest thou upon the poets hearts:
Vulture: Whose wings are dull realities".

The Vista which was disclosed before the poet was more influenced by the English atmosphere as such Poe restored the old wings of poesy and flew to "Eldorado" and travelled into the "Dreamland" which was out of space and "out of time".

The lyrical style of Poe was very simple in expression and direct in appeal. He sang the peoms with full sincerety of his heart.

"But we loved with a love that was more than love.
I and my Inaabel Lee—
With love that the winged Serophs of Heaven
Coveted her and me".

This progress has reached to the climax at the close of his poem:

For the moon never beams without bringing me dreams
Of the beauteous Anaabel Lee,
And the stars never rise but I see the bright eyes
Of the beauteous Annable Lee.
So all the night tide I lie down by the side
Of my darling, my darling, my life and my pride.
In her sepulchre there by the sea,
In her tombs by the side of the sea.

His heart was Volcanic "as the scoriac rivers and" "the lavas that restlessly rolled" but in "Annie" he failed to maintain that spirit in face of his poetic greed for the preservation of the beauty and he wished her to escape "so composedly in bed that death may "fancy" her "dead" and shudder her look "thinking her dead".

The description in "Annie" sounds with the brilliancy of imagery and the musical harmony of the poets heart which was "brighter than all of the many stars in the sky. Like Wordsworth, Poe choiced to draw the eternal pleasure out of the objects of nature.

"Then—in my childhood in the dawn
Of a most stormy life—was drawn
From every depth of good and ill,
The mystery which binds me still
From the torrent of the fountain,
From the arid cliff of the mountain,
From the sun that round me rolled,
In its autumn tint of gold.
From the lightning in the sky
As its passed me flying by
From the thunder and the storm
(When the rest of heaven be)
Of a demon in my view".

The entire range of his poetic choice is glorified with the subject matter of the romantic poets of England. He was similar in the choice of the matter since his genius could not drift to new experiments still he was dissimilar in style. His words and images were chosen in such a manner that the individuality of his expression could peep and spell the heart of his reader. He took direct and the simple words to express his poetic thoughts within the simple and the clear framework of his imagination. He kept himself away from the old lethargy of antique and obscure use of English words.

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CHEMICAL BASIS OF HEREDITY

KARAMCHETI, S. N.

The characters inherited from the parents by the offspring will be carried through "Genes", localised on the chromosomes of the cells. Man has nearly probed deep down into the "Chemical Basis of Heredity", with the isolatin of the little known substance "Nucleic acid".

A great deal of work has been done on these substances and the interpretation of the findings may lead us into the newer horizons on the nature of the chemical basis of heredity.

The story of nucleic acids started in 1860's in a small laboratory of a Swiss biochemist, Friedrich Miescher in Basle, Switzerland. After months of experimentation Miescher found, Deoxyribose nucleic acid", one of the two nucleic acids from the *Rhine salmons* sperm. There at the heart of each cell he found the raw material of life, surrounded by cytoplasm.

Nucleic acids and their structure :

The chromosomes carry genes, which are constituted by the proteins and nucleic acids (nucleo proteins). Like proteins the nucleic acids are high polymers, but polymers with a difference.

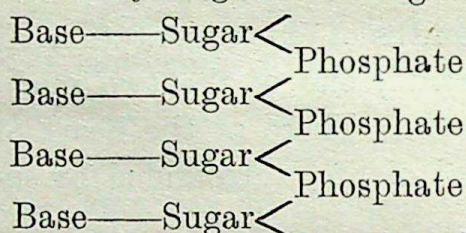
There are two types of nucleic acids, "DNA", short for, Deoxyribose nucleic acid and "RNA" for Ribose nucleic acid. DNA is found only in the nucleus of the cell and RNA in the cytoplasm as well as in the nucleus. Chemically they are very similar, each a long chain, cosisting of phosphate and sugar molecules with small side groups called bases attached to the sugars.

DNA is constituted from three types of building blocks. The first of these is the phosphate, derived from the phosphoric acid, which gives DNA its acid properties. The second which gives its name to DNA, is the sugar called the Deoxyribose,

and the third is a group of four bases containing Nitrogen. The four bases found in DNA are the "Adenine", "Guanine". "Thymine", and "Cytosine".

In RNA the sugar is Ribose and the bases Adenine Guanine, and Cytosine are present as in DNA, but instead Thymine it has "Uracil" as the fourth base.

It has been shown by Crick, F.H.C. and Watson, J.D., that DNA molecule is a double helix with two chains twined round each other. It is so arranged that the sequence of bases on one chain determines the sequence on the other. That is Guanine pairs only with Cytosine and Adenine with Thymine.

The physico-chemical analysis involving sedimentation, diffusion, light-scattering and viscosity measurements indicate that DNA is a very asymmetrical structure, approximately 20A°, wide and many angstroms long.

(Chemical formula for a single chain of DNA)

Less is known about the structure of RNA. There are indications that the natural RNA consists of two chains, but it gives rather poor-X-ray pictures, suggesting an irregular structure. Whether this disorder is inherent in the molecule or produced during the extraction, can not be said, as there is little information to tell, what RNA is like inside the living cell.

Synthetic Nucleic acids :

Progress has been made in the sythesis of nucleic acids with the help of enzymes extracted from living cells. Workers at the New York university discovered an enzyme system in certain bacteria with which they were able to make RNA like molecules. The RNA type polymers were made from diphosphate of the nucleotides, (a single group consisting of a base, a sugar and a phosphate is called the nucleotide) corres-

ponding to the four natural bases. When all the four nucleotides are provided at the same time a product called, "AUGC" was formed. This is very similar to the natural RNA but so far has not shown any biological activity.

Kornberg and others found a different system which produced DNA like molecules. This system requires triphosphate instead diphosphate of nucleotides and of course deoxyribose than ribose. Two conditions appear to be necessary :—

(*a*) all four nucleotides must be present at the same time and if any one is omitted little or no synthesis takes place.

(*b*) the polymerisation will not proceed unless some natural DNA is present as a primer. This provekes great interest and excitement because these two suggest the possibility that the synthetic DNA is produced by replication of the primary DNA, rather than assembled from the raw materials. It is not yet possible to show the biological activity of the synthetic DNA.

Nucleic acids in heredity :

In recent years suspicion has been growing that the key to the specificity of the chromosomes lies not in their protein but in DNA. There is a suggestive evidence in two cases that DNA, alone free from protein may be able to carry genetic information. The first of these is the discovery of the "Transforming principle" in bacteria. It was found that pure DNA extracted from certain bacteria is capable of transforming some of the properties of this strain to a related strain and the transformed bacteria pass these properties on to their descendents. Secondly, when a bacterial virus infects a bacterium, it is the virus DNA and not the protein that enters the bacterial cell and much of DNA turns up in the progeny-virus produced in the bacterial cell.

Taking these evidences it is difficult to resist the conclusion that DNA is the genetic material. If that is the case, our problem

is to understand how DNA reproduces itself. The basic idea is that the two chains of DNA, which fit together as a hand fits into a glove, are separated in some way and the hand then acts as a mold for the formation of a new glove, while the glove acts as a mold for a new hand. This hand-glove hypothesis has been supported by the experiments of Cyrus Levinthal at the university of Michigan, U.S.A., on the DNA of the bacterial-virus by the radio-active tracer method.

The nucleic acid molecule inherited by the living cells bear the plan for all the cell's protein molecules. The master plan which tells an organism, how many and what kinds of proteins to build, is contained in the substance of its genes and passed down from generation to generation through the vast reaches of evolution.

The most convincing evidence that RNA is responsible for the specific construction of proteins has come from the recent work on (TMV Tobacco Mosaic Virus) done mainly by Fraenkel Conrat and his colleagues at the university of California U.S.A. and by Gerhard Schrman and co-workers at the university of Tubengen in Germany. They have separated RNA from the protein of the virus and used separately in combination with different proteins to generate virus progeny. RNA inoculated into Tobacco, produced virus, with the protein corresponding to the virus from which RNA is extracted.

To quote Prof. Waddington, "as soon as we can understand every thing that goes on in DNA it will be possible to make black, a white. If we can change DNA we can change heredity".

INTER LIBRARY LOAN*

(the most effective measure to fulfil the demand of every patron and the First step towards Library Co-operation)

D. G. SANGAL

With the progress of the scientific knowledge, every branch of human affairs has been accentuated with the systematised mode of learning to bring home a pattern which may effuse the maximum facilities for the advancing wisdom and eliminating wastage with the minimum use of time, money and energy. Libraries are no more merely the abodes of literature and scholarship but they are motivated as positive agents in the extension of their use. Thus the purpose of inter-library loan is, to enable a library which does not possess a particular book to borrow it from some other library which stocks it.

Since the very inception of the scheme of inter-library loan, it was accepted as a useful handmaid by librarians. But at the same time it has been subjected to some unhealthy criticism. "Presumably it has been provoked by the scant understanding of the scheme. It is certain if the scheme is spot-lighted with all its mighty potentialities, much of the wrongly directed criticism will fade away, yielding the place to harmonious efforts, so essential for"† minimizing the acute shortage of funds in the libraries, fulfilling the Laws of Library Science and establishing co-operation among the libraries.

A library is an agency for the dissemination of knowledge, promotion of research, encouragement of teaching and stimulation of reading. It is a centre for the development of cultural heritage and promotes social homogeneity and social interaction by providing intellectual recreation and above all is a

*The writer presented this subject in the seminar, as the Leader of the same, conducted under the auspices of the Dept. of Library Science and directed by Shri P. N. Kaula.

†article : "Co-operative Farming in India",—D. G. Sangal.

medium for creating mutual understanding among the nations of the world. The day is gone when the library was mereltya storehouse, a reservoir or at the most a museum where the documents were preserved for posterity. Today not only he storehouse has been converted into a workshop, not only the cistern has been made a fountain, not only the museum is functioning with a spirit of salesmanship but also a librarian carries a tremendous responsibility of creating and fostering an enlightened citizenship by transforming the potential energy accumulated in documents into kinetic energy in the minds of patrons. He serves as a guide, a torch-bearer to the study of the recorded knowledge. But the terrific race between knowledge and book production has made it impossible for any library, howsoever big it may be, to purchase all the documents, produced in the world.

Under these circumstances some method had to be introduced by which libraries could get facilities to utilize the resources of other libraries for the benefit of their own patrons. The Second Law of Library Science demands books for All, for every class of persons, nay, every individual, irrespective of his or her social, political, economic, cultural or religious status. "It may not be possible for each (library) to find sufficient funds to provide Every person his or her book. Even if funds are forth coming it will be highly wasteful to do so. (Because the library may not find any other patron for certain books for many years to come. Therefore it would be against the "Law of Parsimony" to invest money on such books). While each library should own one or more copies of certain ordinary books, it is not conducive to national economy for each of them to buy copies of costly or occasionally used books. In fact, it is necessary that the library authorities should arrive at an agreed scheme of specialisation. In such a scheme each library will have its share".* and the complete collection of a library will be according to the local needs. For example if Varanasi is mainly populated by religious persons and Kanpur

*Dr. S. R. Ranganathan: "Five Laws of Library Science".

by persons having interest in industries, it would be economical if the public library at Varanasi, in addition to books of popular demand, specilise in the material on religion and public library at Kanpur in literature on industries. Whenever the readers at Varanasi need books on industries, these can be borrowed from public library, Kanpur through inter-library loan and vice versa.

The question is not merely a financial one but many scare books, manuscripts and back volumes of periodicals can not be purchased at any cost. Suppose even if a copy of such material can be bought, it may take so long to trace, that it is too late to be of use to the patron by the time it arrive. Therefore the question of inter-library loan becomes one of necessity and the libraries have to depend on one another to supplement their own resources.

Again, through inter-library loan many unused books are mobilized and they are used where they are needed. In this way the Third Law of Library Science, EVERY BOOK MUST GET ITS READER, is also served. Money saved thus can be utilised for the documents for which there exists a popular demand. At the same time libraries can also claim to provide any document, a patron wants, by banking on the resources of sister libraries.

Moreover, inter-library loan is not only the oldest but the most frequently used method of access to the documents lying in other libraries. It is probably the First step and the earliest form of co-operation among the libraries. Fundamentally inter-library loan is not different from usual loan, from a library to a patron. In essence all the libraries which are willing to cooperate become a single unit with tremendous extension of their boundries. A family spirit is created among the libraires and a sense of oneness and brotherhood develops among the library personnel. It is because of this spirit that several countries have gone to the extent of rendering free postal service for the patrons of other libraries also. This spirit of cooperation would induce librarians to join their hands for other

library activities too. Obviously it is not only a great weapon for library development but is bound to strengthen the library movement in the years to come.

In order to achieve the foregoing, it is essential that the libraries in our country must be linked up together in a hierarchy with clear division of responsibilites at each level for the proper functioning and best results which may lead to a free, quick, uniform and standard service for each and every citizen of the country. It is for this purpose that a pyramidal library structure or a systematic library net-work must be formed in the form of National Central Library at the top, to look up to the requirements of the nation as a whole, a State Central Library for each state to look up to the requirements of the state and libraries at every district level, linked up with branches, deposit stations and mobile vans to rural and urban areas to meet the demand of each and every individual of the community even if he or she resides in some remotest hamlet in the interior. In such a system, the librarians with the help of their Union Catalogues as tooks and the vast resources built up at the national and state level through a 'Copy Right Act' would only make library service a reality in the form of service to 'ALL' which still exists as utopia for so many countries of the world.

In the end it can be emphasized that—"साहित्य और समाज में परस्पर अटूट संबंध है । हमें समाज का या कहिये कि अपने युग का नवनिर्माण करने के हेतु—(समस्त देश में आदर्श पुस्तकालयों का संस्थापन एवं परिपोषण) करना होगा । इससे नागरिक लाभ उठावेंगे, देश सब क्षेत्रों और दिशाओं में उन्नति करके सर्वोत्कृष्टता को प्राप्त होगा । और यह होगा भी क्यों नहीं ? हम करेंगे—(कुशलतम पुस्तकालय सेवा का संचार और पुस्तकालय) करेंगे हमारे लिये 'नवयुग' का निर्माण ।"*

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*Present article writer's First Prize awarded essay: "Sahitya aur Samaj".

DISGUISED UNEMPLOYMENT AND ECONOMIC SURPLUS : ITS MAGNITUDE AND MOBILISATION

C. P. PATHAK

The problem of 'Economic Surplus' associated with what has been described as 'disguised unemloyment' which exists on a fairly large scale in the agricultural sector of the densely populated under-developed economies, such as ours, has engaged the attention both of the academician and the planner. It is common knowledge that demographic and social conditions and institutional framework of the under-developed economies permit absorption of growing population on land in particular, almost to a point where the marginal productivity of labour is zero or even negative, and, therefore, it is possible to obtain the same output even with a smaller labour force. There exists, therefore, surplus man-power and though there may be difference of opinion as to its composition or magnitude or whether it is only seasonal or perennial, the fact of its existence cannot be questioned.

Again, it is admitted that this surplus labour cannot be absorbed by means of monetary demand in the absence of complementary resources and accordingly a rigid supply of wage-goods at least in the short run. In other words, it is not a problem of effective demand but one of a higher rate of capital accumulation, technological progress and reduction in the rate of growth of population.

The surplus people may be taken away from land and utilized on investment projects to produce real capital. Now, it is the nature of investment that it can increase the supply of wage-goods only after a certain time-lag ; the length of this time-lag will depend upon the nature of the investment that is undertaken. The question then arises how are the labourers to be fed in the interim period ? Prof. Nurkse provides an

answer to this question thus: "Disguised unemployment implies at least to some extent a disguised saving potential as well......As things are the unproductive surplus labourers on the land are sustained by the 'Productive labourers'....... The productive labourers are performing a 'virtual saving': they produce more than they consume......But the saving runs to waste, the saving is abortive ; it is offset by the unproductive consumption of the people who could be dispensed with...... If the productive peasants were to send their useless dependants .... to work on capital projects and if they continue to feed them there then their virtual saving would become effective saving*". Prof. Nurkse recognises that there may be practical difficulties in mobilising this concealed saving potential ; that there will be leakages in the form of increased consumption by the remaining peasants and through the cost of transporting the food from the farms to the places where the capital projects are established. Moreover, the newly employed people will also want to consume more than they did previously when they were unemployed.

This thesis needs careful examination and it appears that despite a good deal of thinking done on the subject, its limitations are not fully appreciated even today.

Utilisation of surplus labour for capital formation while continuing to feed them as at present, is fairly realistic and comparatively a simple affair, if investment is conceived of within the framework of household as a productive unit or the village, whether collectivised or co-operativised, as a productive unit or through 'shramdan' (voluntary labour) or community development projects.

Within the framework of joint family system, investment projects like digging of wells, fencing etc. may be undertaken to utilize the surplus manpower in the household and usually the system will adapt itself to minor changes that may be required in the distribution of consumption goods within the members of the household. But the scope of investments that can be

*R. Nurkse. "Problems of Capital Formation in Under-developed Countries" page 37 ed. 1955.

undertaken thus, is strictly limited. There is another possibility which needs to be taken into account in this connection. The awareness on the part of the household to undertake such investment beyond the levels at which it is already being undertaken will be the result of certain changes, economic and social, which may also occasion a disintegration of the household itself and may therefore transform the problem of disguised unemployment into one of open unemployment.

Investment possibilities conceived within the frame-work of village as a productive unit are considerably larger and the distributional problem involved in feeding the persons employed on such projects is not difficult of solution if the force which binds the people into the village-unit is effective. In a collectivised village after making available the labour required for farm operations, the surplus labour may be utilised on minor irrigation, afforestation, reclamation and soil improvement projects which may be financed by the farm itself. The farm instead of paying wages to such labourers, will credit them with work-days done by them and at the time of harvest they will receive a share in the product. Similar projects may be undertaken under co-operative farming also by an agreement between the members or by established customs and conventions and financed through the necessary adjustment in the share of the product accruing to the members.

This is, however, not all. Under collectivised or co-operativised village system, the Govt. can impose creation of compulsory reserve stocks of food to be utilised for payment to workers engaged on schemes of capital construction. Or the Govt. may procure a certain part of the output at prices lower than those that will prevail in the open market either in payment of land revenue or for cash or for permits for other esentials of life required by the village people. and thereby mobilise a part of the product (excess taken through low acquisitional price) which whould otherwise not be available and then utilized it for capital construction, possible for financing bigger capital projects which cannot be undertaken at the village

level. Apart from administrative and other problems involved is such compulsory procurement schemes, it seems difficult that a government which has to court the peasants for votes will undertake the political risk involved in it. Generally speaking, therefore, the scope of such investment is limited and even this depends on the effectiveness of the binding force of the village organisation.

It is again possible to undertake investment on local projects without creating redistributional problems through voluntary effort organised by community development projects. The record of community development projects in our country however, does not raise much hopes of tackling the problem in this manner. Moreover, such projects themselves call for funds for propeganda, planning and for setting up the required machinery.

From what has been said thus far, it follows that while it is useful to work along these lines, this by itself will not solve the problem either of those already displaced or those that will be displaced as a result of institutional and technological change following economic development. We must, therefore, examine how large Prof. Nurkse's 'Large Saving Potential' is likely to be and how far it can be mobilised to offer employment for a wage on investment projects i.e. on capital construction.

In regard to the size of the 'surplus' which may be available for capital formation, our contention is that it is not likely to be large for two reasons*.

1. Insofar as labour is drawn for investment projects from among the already displaced persons, there is no 'surplus' which could be available ; and

2. Insofar as the disguisedly employed persons are taken away from productive households which are on the margin of subsistance, it is difficult to call the consumption of the people now displaced from land for employment on investment projects as 'virtual' saving done by other members of the household.

*Dr. K. N. Raj. Lecturers on 'Employment Aspects of Planning in Under-developed Economies, published by National Bank of Egypt, Cairo 1957 Page 23.

The surplus, if we can still use the term, will therefore, be negligible. We can of course say that there is a 'virtual' saving done by comparatively better-off productive households in sustaining surplus manpower which they cannot utilise on the farm. If these surplus persons be taken away from land and the remaining persons do not increase their consumption, there will emerge a surplus which cannot be called negligible. Yet we remember that the pressure on land in our country is so great and the holding in most cases is so small, we shall find that all this surplus may not total up to any large figure. Moreover, it is to be realised that labour can be displaced from such households only at a comparatively higher wage rate, the cost of capital construction would correspondingly be higher and in real terms and from the employment point of view also the result may not be very impressive. This is not to suggest that this surplus should not be tapped but it only indicates that the surplus is not as large as Prof. Nurkse has made it out to be.

Although the economic surlpus associated with disguised unemployment in the agricultural sector is not large, there is another source of surplus to which Dr. Raj makes a reference. In paying rent and interest the productive households do in fact save. This saving may be the order of 20 to 25 percent or even more of the agricultural output of the majority of the agricultural household. Even if we make an allowance in this for the part appropriated by the State as land revenue or for a reasonable payment for the services of capital provided to finance agriculture, there is left a considerable surplus appropriated by persons and intermediaries whose contribution to the output is nil and who live upon the efforts of others. The receivers of rent and interest may be having some saving out of it and may be investing it in the urban sector. But such investment must be very small. It can, therefore, be said that a major part of saving done by productive peasant households in the form of rent and interest payments, finally runs to waste, so far as capital formation is concerned. When, therefore, we

consider the question of mobilisation of economic surplus from the agricultural sector for capital formation, we should not only not ignore this surplus but should probably. at leat in theory devote greater attention to it than to the surplus to which Prof. Nurkse has alludded.

We have already dicussed the methods of mobilisation which may be adopted to implement schemes of investment and creation of social overheads within the framework of the household or the village as the productive unit. Now we may refer briefly to methods of mobilisation to finance bigger schemes where labour would be displaced from land and employed for a wage.

Russian experience suggests to the machinery of collective farms and compulsory procurement. Installation of Russian model is not possible within the political set-up of our country. China has in recent years mobilised a part of the rental surplus through grain tax and a part of it has been now left in the hands of the producers themselves by reducing the rents paid by them. Mobilisation of rental surplus the Chinese way is again limited in our country by social and political factors. We may recall the abolition of Zamindari in Uttar Pradesh. Since our constitution accepts the principle of compensation, the expropriated landlords have been paid in the form of zamindari bonds. These will be liquidated in 40 years. The cultivators who have paid ten times the rent they formerly paid, have acquired bhoomidari rights and the rent paid by them after acquisition of such rights has been reduced to half so that the State is receiving from them only as much as it used to receive from the landlords previously. Beyond the mobilisation of the hoarded savings therefore, this has only resulted in a reduction of the rent paid by the cultivators. Other cultivators whose rents have not been reduced no doubt contribute to the public treasurey and to that extent the rental surplus may be said to have been mobilised. But then, is it available for investment ? No. For some forty years this will continue to be transferred to the old zamindars in payment of the bonds. Insofar as sub-

leting has been made difficult, this has only led to an increase in the number of displaced households.

Interception of the economic surplus the Japanese way through land taxes is again beset with administrative difficulties and may not be considered politically expedient. Moreover, where rental income is widely dispersed in small amounts among a large number of households of small means, it is difficult to collect it through land taxes. Even if it could be done, it will still leave unsolved the problem of surplus in the form of interest.

Indirect taxes on commodities purchased by agriculturists may be used to impose and mobilise savings from agricultural sector, or inflation may be used to create forced saving. Again a carefully devised price policy of moving the terms of trade against the agricultural sector and in favour of the industrial sector may be able to mobilise a part of the surplus. Each one of these methods has its own limitations and difficulties. For instance, indirect taxation on agriculturists sounds ethically and economically good if the incidence of tax is mostly on those groups whose incomes are large. However, among other things, if it is a question of interception of the surplus in the form of rent and interest, it is difficult to devise such indirect taxes that will just intercept this surplus and not impinge otherwise upon the mass of poor cultivators. Inflation, on the other hand, as a method of mobilisation is not justified because of its undesirable distributional effects and other problems that it creates. Mobilisation through manoeuvring the relation between prices of agricultural products and those of manufactured goods which the agriculturist buys, raises conceptual difficulties e.g. What should be considered the proper relation between such prices and how such relation should be changed with change in circumstances etc. ? Moreover implementation of this policy will call for imposition of controls which do not seem to find favour with the people and an administrative machinery is hardly anywhere near the level of efficiency (and honesty) at which it will have to function to enforce such a price policy.

This analysis, therefore, suggests that though possibilities of mobilising the economic surplus from the agricultural sector for investment into capital projects do exist, these are only limited from practical point of view. Attention must, therfore, be paid to increasing the surplus through the application of known techniques which do not call for much investment but which can greatly increase the productivity of land for which there is a great scope in our country.

SAFFRON IN KASHMIR

AUTAR KRISHEN JALALI

Saffron producing area of Kashmir is one of the beauty spots of Kashmir valley which is known for its gardens, orchards, meadows and green fields. Kalhana in Rajatarangni describes this beauty spot as—"Kashmir is a country, where the sun shines mildly, being the place created by Kashapa as if for glory. High storeyed houses, saffron, iced water and grapes, which are rare in heaven, are common here".

Origin and History :

It is gathered that saffron plant originated in the Mediterranean centre. According to Vavilov it came from Greece and Italy.

There is no available record which could throw light on the early history of saffron in Kashmir. It is mentioned as a necessary ingredient in certain important prescriptions of Vaghbhatta and Sushrutta. But from Kalhanas' Rajatarangni, it can be said that the saffron in Kashmir must have been cultivated before the times of Lalitaditya. There are legends to show that it was grown at Padampore (which is now called Pampore, about 8 miles from Srinagar). One of the legends handed over from ancient times about 800 A.D. is that there was a physician living at Padampore, who got a bulb of saffron as a reward from a Nag or Snake God for curing him of an eye complaint. From that time the cultivation of saffron is believed to have sprung up in this part, even today farmers of the area celebrate the day in his memory near a recognised pond. It is said that during a famine period in the valley the inhabitants ate all the bulbs as their food, and after 300 years, sometime in Mughal period, the seeds were imported from Iran and even since Kashmir is famous for the production of saffron.

Botanical Description :

Botanically called *Crocus sativus Linn ;* this tiny plant has got its place in the family Irrideacea, which includes many of the choiced horticultural plants such as Irises, gladiola etc. Crocus (a Greek name Crocus for Saffron), apart from sativa, contains more than 75 species, but the most common are only 8-10. The plants propagate by Corms, which are about 1-1¼ inches across, large globular and compressed. Leaves are radical, long slender grass like, channeled above the edge turned back and fringed. They are grey green in colour, white beneath, numerous cilliate and the lower portion of the leaf bundle is surrounded by sheaths of thin translucent, whitish tissue.

The flowers fragrant, solitary or in bundles enclosed in two valved spathe, embracing the scape. They are light violet in colour and usually appear in autumn with the leaves. The flower is marked by its large parienth, which is tube like and slender funnel shaped. The limb of the parienth is sub-equally six lobed in two series. The six segments are almost equal in form and in size, though the inner ones are invariably somewhat shorter than the outer ones and are concave, narrow and oblong. The throat of the tube is bearded. Stamens are attached to the base of the outer segments. The filaments are free and anthers are yellow in colour. The ovary is egg shaped and is hidden between the bases of the leaves. The style is thread like and branching into 3 style arms i.e. stigmas which are exerted, tubular, orange red in colour and subclavate. The tips of these stigmas may be either entire or lobulate. The stigmas constitute the saffron of commerce. The capsule is spindle shaped and the seeds are roundish.

Cultivation :

Saffron cultivation is practised on certain plots of lands, situated in 17 estates of Tehsil Awantipora and 4 estates of Tehsil Srinagar, all lying in the Karewas (elevated dry table lands of alluvial origin, 5,300-5-400 feet above sea level), adjoining Pampore town. The total area of these fields is 26, 800 Kanals* (3, 350 acres).

* Kanals = 1 acre

Preparation of the field :

The culture of saffron is sufficiently easy, and if scientifically approached, it will produce a good crop. As the crop reproduces by bulbs, the drainage becomes one of the primary conditions for its better growth. As bulbs in water logged conditions rot fields are raised into beds with convenient slope. Alround the bed, there should be surface drains, giving the field a shape of vegetable nursery. The soil is prepared thoroughly. The ploughing operations commence from mid of March and continue till mid of August, during which 5-8 ploughings are given ; plots are laid out as 5-6 feet squares with 6 inches drain alround. This is practised in those lands where the sowing is done afresh. In other lands where the crop is harvested from the previous years ploughing is likely to injure the corms. Thus there, the preparation consists of hand digging and careful laying out of the beds.

Soil requirement :

The quality of the soil is somewhat peculiar. It is a bit yellowish and is locally called as 'Gurut'. Alkalinity to some extent is desirable for a better stand. According to Leather, the late Imperial Agricultural Chemist, the soil of Pampore contains nothing in it, that would make it especially suitable for saffron. But experiments have proved that saffron does better in the soil of Pampore and Leather is of the opinion that it is because of the situation of the general physical conditions of the soil. A trial to cultivate saffron during last five years in the Provincial Agricultural Experimental station, Shalimar has shown that inoculation by Pampore soil is essential before starting cultivation of saffron for the first time in any new locality.

In a hopeful experiment of this kind at Alwar, near Delhi, Mr. Landseer started bulb growing on earth brought in barrels from Kashmir. But in the second year the five beds of bulbs increased to nine, and as there was no further import of Kashmir earth, native soil had to be used with success. (Kritikar 1918). Trials on this aspect are worth undertaking.

Sowing and rotation :

As mentioned above the crop is sown by corms at the rate of 32-48 mds. per acre. The usual time of planting being July or first week of August. A bulb once sown continues to bear crop for 10-12 years and experience has shown that uneven fields get exhausted sooner than plain ones. To get better yield, cultivators follow rotations. They rotate this crop with cereals and mustard. Commonly grown cereal crop in this area is wheat. Some cultivators leave the land fallow for 8 years, but very few practice it. The general rotation therefore stands as.

Saffron—saffron—saffron (ten years)—wheat—barley—oil seeds—wheat—saffron i.e. saffron brought in again after a lapse of four years.

Care after sowing :

No manure is applied to the fields and experience has shown that bulbs do not thrive well on the fields which contain decayed humous and stable manure (Fotedar 1935). Depending on the nature of cultivation, hoeing and weeding is done. In freshly sown fields first hoeing is given just before flowering to a depth of 4 inches and in subsequent years the frequency of weeding is increased, first hoeing and weeding being given 2 weeks in the beginning of August, in all 3 hoeings are given.

Irrigation :

Saffron is totally a rainfed crop in Kashmir and only timely rains help to produce a good crop. Rains in the month of May are quite harmful, as they cause a disease known as "Chira Havuk". This disease is caused by the deterioration of the bulbs and is fatal to them. Occasional rains from July to September are considered highly benefitial and are much needed. Once the flowering starts in October, there should not be any rain till they are picked up, dried, and processed because the rains during this period cause rotting of the flowers and deteriorate the quality and reduce the quantity of the produce.

Picking and grading :

Harvesting starts in the month of November or the last week of October and picking up of flowers is usually done by hand. Picking up consists of collecting of flowers and drying them in the sun. After the flowers have fully dried, the three long stigmas are picked up by hand. The stigma determines the quality of saffron and its price. When the upper portion of the stigma, which is red orange in colour, is picked up the saffron is of a fine quality and is locally called as "Shahi" saffron. On the other hand, if the lower portion of the stigma is picked up, the saffron is of a very inferior quality. This can be determined by its slight whitish appearance which is due to the white basal portion of the stigma. This type of picking up in dry condition is named as "Mogra" and the extracted portion fetches price, as high as Rs. 5.00 per tola (Rs. 200.00 per lb.)

Saffron is further extraction of saffron, from the remains of the flowers from which the stigmas have already been removéd. The process consists of heating the remaining sun-dried flowers with sticks, and then plunging them into water and this process is repeated two to three times. The portion remaining at the bottom is taken out and is called "Niwal". Each time poor quality of 'Niwal' is obtained. Thise xtracted portion or 'Niwal' is used for adultration. This type of saffron has a faint colour and mild odour. The trade name of the 'Niwal' is Lacha and it fetches less price than Mogra.

Yield :

From the commercial point of view one grain of good saffron contains the styles and stigmas of nine flowers so the formation of one ounce will require 4,320 flowers. The yield in the first year is either negligible or very low but it increases gradually and within three years normal yields are obtained. After four to five years of normal yield, there is a gradual decline in the outturn of saffron. The average yield per Kanal of land is 4-5 ounces (32-40 ounces per acre).

Economic Importance :

The stigmas besides being an article of good omen, among

Hindu Brahmins, who use it as Tilak, have so many other uses. It has medicinal uses in fevers, melancholia and enlargement of the lever. It is also a stimulant and possesses stomachic properties and is highly thought of as a remedy for catarrhal effections of children (Kirtikar 1918). The popular use of saffron is as condiment for which it has got a large demand, and as such is used in certain Indian dishes to impart them colour and aroma.

In European countries it is used in dyeing processes but has gradually decreased due to the development of the technological processes. Mullahs (Priests) make a kind of ink with this substance with which they write charms (Emerson). Saffron in Kashmir is famous for its bouquest and for its great medicinal value. Its byeproducts i.e. petals etc. in green stage, after saffron is extracted are used by cultivation as a spice for cooking fishes. Formerly regarded as antispasmodic and emmenagogue, saffron at present is chiefly used as a colouring and flavouring agent.

Conclusion :

The limiting factor for the cultivation of saffron is mainly climate though topography is also an important consideration. It has a localised cultivation in a very limited part of the estate. Its cultivation as already observed does not require any special technique and science. However, experience plays a very dominant role in raising saffron.

If saffron cultivation is extended within the Kashmir valley the state may earn more revenue through exports. A careful examination of the saffron area shows that its cultivation can definitely be extended within the valley. There is a complete absence of any research on saffron, and it will be to the advantage of farmers and the State, if such a centre is organised in Pampore. Further investigations are necessary to find out if its cultivation which can also be extended to Himalayan regions of Uttar Pradesh and Assam.

Acknowledgement :

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THE EVOLUTION OF THE ALANKARA SHASTRA

SHIVANATH SHARMA PANDEY

It is extremely difficult to give an accurate definition of Poetry. But true poetry (whether a work clothed in prose or poetry) is distinguished at least by three things, by a certain peculiar diction, by its subject matter and by the spirit in which it approaches the handling of its themes. From this point of view, the Rigveda contains, though it is a religious book of fervent prayers, a great deal of true poetry. Many of the hymns, particularly those addressed to Ushas, exhibit fine specimens of poetry[1]. In द्वा सुपर्णा[2] etc. there is a fine idea, which would be regarded as the figure of अतिशयोक्ति by Sanskrit Alankārikas. One may trace the desire for श्लेष in such Vedic passeges as 'स्वसुर्जारः शृणोतु नः' (Rig VI/55/5) and in 'यत्रासुपर्णा अमृतस्य' etc. (Rig. 1/164 : 21) explained in Nirukta III, 12 in two ways. The upnishads, though they are devoted to the pursuit of philosophical truth, also contain highly poetic passages[3]. Similarly the verse 'आत्मानं रथिनं विद्धि शरीरं रथमेव तु'' (कठ- 1. 3. 3) contains a good *Rupaka* and the verses 'इन्द्रियेभ्यः परा ह्यर्थाः

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[1] आ घा योषेव सूनर्युषा याति प्रभुञ्जती ।

(a) जरयन्ती वृजनं पद्वदीयत उत्पातयति पक्षिणोः ।। 1-48-5

(b) सह वामेन न उषो व्युच्छा दुहितर्दिवः ।
सह द्युम्नेन बृहता विभावरि राया देवी दास्वती ।।

(c) उवासोषा उच्छाच्च नु देवी जीरा रथानाम् ।
ये अस्या आचरणेषु दध्रिरे समुद्रे न श्रवस्यवेः ।। 1-48-3

(d) विश्वस्य हि प्राणनं जीवनं त्वे वियदुच्छसि सूनरि ।
सा नो रथेन बृहता विभावरि श्रुधि चित्रामघेटवंभू ।। 1-48-10

(e) सं नो राया बृहता विश्वपेशसा मिमिक्ष्वासमिलाभिरा ।
सं द्युम्नेन विश्वतुरोषो महि सं वाजैर्वा जिनीवति ।। 1-48-16

[2] द्वा सुपर्णा सयुजा सखाया समानं वृक्षं परिषस्वजाते ।
तयोरेकः पिप्पलं स्वाद्वत्त्यनश्नन्नन्यो अभिचाकशीति ।। (Rig 1.164.20)

[3] धनुर्गृहीत्वौपनिषदं महास्त्रं शरं ह्युपासा निशितं संधयीत् ।
आयभ्यतद्भाव गतेन चेतसा लक्ष्यं तदेवाक्षरं सोभ्यविद्धि ।। (मुण्ड ।।. 2.3)

अर्थेभ्यश्च परं मनः' etc. contain the figure *sāra*. In the Rigveda, there are several hymns, that contain charming dialogues, viz the dialogues of *Saramā* and the *Panis* (Rig. X 108) of the rivers and the sage Vishwāmitra (Rig. III, 33) These dialongues are the precursors of the Sanskirt drama.

Coming to later days, there is ample evidence to show that centuries before the Christian era poetry of a high order had been composed. It is accepted by all scholars that the Mahābhārat, at its extant form, can not be placed later than the 2nd century A.C. Similarly the Rāmāyana has been assigned to the 4th century B.C. by some scholars[1], while others would place it as for back 600 B.C.[2] These two Epics contain highly poetical passages. Many passages are quoted from the Mahābhārat, in the Dhvanyāloka[3] and the Kāvyaprakāsh[4] and a few from Ramayana[5]. The Mahābhārat is more of a *Dharma shāstra*, than a *kāvya*, though the work itself asserts in no mood of vanity, it has inspired many poets[6]. The Rāmāyana is truly a *kāvya* at its main purpose, its form and contents. It abounds elaborate descriptions and flights of fancy, for example, the highly poetical description of the sea[7], the imaginative descriptions of the sky in सुन्दरकाण्ड[8] etc. may be referred to in this

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[1] Dr. Keith in JRAS 1915 (p. 320).

[2] Like Dr. Jacobi.

[3] Page 125 and 238.

[4] 4th ullās गृधगोमायुसंवाद in शान्तिपर्व 153.

[5] ध्वन्यालोक p. 63 'रविसंक्रान्त' etc. which is अरण्यकाण्ड 22-13.

[6] इतिहासोत्तमादस्याज्जायन्ते कविबुद्धयः—आदिपर्व 385 and इदं कविवरैः सर्वैराख्यानमुपजीव्यते :—आदिपर्व 389.

[7] 'हसन्तमिव फेनोघैर्नृत्यन्तमिवचोर्मभिः' in the युद्धकाण्ड (4-110ff).

[8] सचन्द्रकुमुदं रम्यं सार्ककारण्डवं शुभम् ।
तिष्यश्रवणकादम्बमभ्रशैवलशाद्वलम् ॥१॥
पुनर्वसुमहामीनं लोहितांगमहाग्रहम् ।
ऐरावतमहाद्वीपं स्वातीहं सविलोलितम् ॥२॥
वातसंघातजालोर्मिचन्द्राशुशिशिरांबुमत् ।
भुजंगयक्षगंधर्वप्रबुद्धकमलोत्पलम् ॥३॥
हनूमान्मारूतगतिर्महानौरिव सागरम् ॥४॥ सुन्दर ५७-१-४

connection. The दशरूप advises the authors of dramas to draw upon the Ramayan and the Brahtkatha for their plots. The quotation 'अक्रूरे ददते मणिम्' in the Nirukta (II 2) seems to be taken from some secular poetic work. The sūtra of Pāṇini (अधिकृत्य कृते ग्रन्थे IV 3.87) indicate the existance of secular works before Panini's day, which might have been poetic. Namisādhu on Rudrata (II. 8) tells us that Panini wrote Mahākāvya called 'Pātāla Vijaya' and then quotes one verse and a portion of another from that work. Rājshekhar attributes the composition of the Kāvya, 'जाम्बवती जय' to the grammarian Pānini. The Suvriti Tilaka[1] says that Pānini excelled in the composition of the *Upjati* metre. Many verses ascribed to Pānini in the anthologies,[2] out of which the verse उपोढ़रागेण occurs in the Dhvanyāloka (P. 35 without name) and the verse ऐन्द्रं धनुः in Kāvyalankāra-Sūtra Vritri of Vāman[3], whether Pānini, the grammarian or the poet or the two Pāninis are identical, is rather doubtful. A *vārtika* on 'अधिकृत्य कृते ग्रन्थे' (Viz, 'लुम्बाख्यायिकाभ्यो बहुलम्') shows that the class of composition known as आख्यायिका existed long before Patanjali. The latter speaks of a *kāvga* composed by Vararuchi.[4] Patanjali, while commenting on the vārtika[5], mentions by name three works of the आख्यायिका class, viz. वासवदत्ता सुमनोत्तरा and भैमरथी[6]. He referes to the two works dealing with the death of *Kanishka* and the humalitation of Bali and dramatic representations of these themes[7]. In another passage, he makes a reference to the wives of actors[8]. The Mahābhāsya contains many quotations from the works of poets, that went

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[1] (III-30)

[2] Peterson's Preface to Subhāshitāvali, p. 58 and J.R.A.S. 1891 pp. 311-316.

[3] IV 3. 27.

[4] 'यत्तेनकृतं न च तेन प्रोक्तं वाररुचं काव्यम्' । (महाभाष्य Vol. II, p. 315).

[5] लुम्बाख्यायिकाभ्योबहुलम्'

[6] महाभाष्य Vol. II, p. 313 and 284.

[7] Vol. II 34 and p. 36 ये तावदेते शोभनिका नामैते प्रत्यक्षं कंसं घातयन्ति प्रत्यक्षं च बलिं बन्धयन्तीति ।

[8] 'नटानां स्त्रियो रङ्गं गता यो यः पृच्छति कस्य यूयं कस्य यूयमिति तं तंतवतवेत्याहुः । (Vol. III, p. 7).

before it, some of which possess poetic charm[1]. The verse एति etc. occurs in the युद्धकाण्ड[2]. The proceeding after brief dis-scussion shows that from atleast 500 B.C. to 100 B.C. a great deal of poetical meterial of a secular character had been accu-mulated in classical Sanskrit. This must have naturally led to speculations about the functions and objects of poetry, the classifications of different kinds of poetry, the enuncia-tion of Rules about the standard form of certain classes of composition and to establish a theory of poetics and literary criticism.

Epigraphic records of the 2nd century A.C. and onwards show that before that period a theory of poetics had been envolved. The inscription of Rudradāman at Junāgarh (150 A.C.) sheds very great light on the stage, the poetics had reached by that time. The preserved portion contains only two verbs, it is written in prose with long compounds, full of alliteration and other tricks with words[3]. This shows that before the 2nd century, *kāvya* had been divided into गद्य, पद्य and some of the gunas that figure in later works that had been already named स्फुट, मधुर, कान्त, उदार. Both गद्य and पद्य were required to be अलंकृत. The composer of this inscription was evidently trying to come up to the standard of a good poet laid down in the works on poetics. This inscription represents a mediocre attempt, what a kāvya in those days was required to be. An inscriptions of the 4th century A.C. contains a panegynic of the great Emperor Samudragupta by

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[1] 'असिद्वितीयोनुससारपाण्डवम्' 'संकर्षण द्वितीयस्य बलं कृष्णस्य वर्द्धताम्' (Vol. I, p. 426) 'जघानकंसं किल वासुदेवः' (Vol. II, p. 119)
'जनार्दन स्वात्मचतुर्थएव' 'प्रियां मयूरः प्रतिनर्नृतीति' 'यद्वत्त्वं नखर नर्नृतीषि हृष्टः (Vol. III, p. 335 ; p. 143, p. 338).

[2] 'एति जीवन्तमानन्दो नरं वर्षशतादपि' (Vol. I, p. 277)
'वरतनु संप्रवदन्ति कुक्कुटः' (Vol. I, p. 238) (128.2 where it is called लौकिकी गाथा)

[3] 'सर्वक्षत्राविष्कृतवीरशब्दजातोत्सेकाविधेयानां यौधेयानां प्रसह्योत्सादकेन···शब्दार्थगान्धर्वन्यायाधानां विधानां महतीनां पारणधारणविज्ञानप्रयोगावाप्तविपुलकीर्त्तिना····स्फुटलघुमधुरचित्रकान्तशब्दसमयोदारालंकृतगद्यपद्य····स्वयमधिगतमहाक्षत्रपनाम्ना नरेन्द्रकन्यास्वयंवरानेकमाल्यप्राप्तदाम्ना महाक्षत्रपेणरूपदाम्नां ।

Harisena. This प्रशस्ति tells us that the title '*kavirāja*' had been applied to Samudragupta on account of the composition of many *kāvyās*. That were the source of inspiration to learned men. These inscriptions, therefore, show that long before the 2nd and 4th century, poetics had made a good deal of progress. The Budhacharita of Ashwaghosha, as it was translated into Chinese about (414-421 A.C.), was composed at a time when some theory of poetics had already been in vogue. Each canto has at the end a verse or verses in a different metre. The author is very much after alliteration, employes such a frightful jingle as 'हरितुरग तुरङ्गवत्तुरङ्गः' (V 87) and is very fond of यथासंख्य (V. 42 and IX 16). He uses the techanical words हाव and भाव[1]. The Natyashāstra of Bharat must have been composed not later than 300 A.C. It contains a full exposition of the *Rasa* theory, of dramaturgy and four figures of speech and *gunas*. Subandhu, in his Vasavadatta alludes in various places, the topics of poetics. He boasts of his skill in weaving a web of puns on each syllable[2], speaks of वक्रोक्ति of the soul of poetry, of the composition of an excellent poet in which the explatives तु and हि do not occur and which is divided into long sections and contains *vaktra* metre[3]. He speaks of शृंखलाबन्ध उत्प्रेक्षा and आक्षेप[4]. Bana speaks of such puzzles as अक्षरच्युतक, मात्राच्यतक, बिन्दुमती, प्रहेलिका etc. He knew the difference between कथा and आख्यायिका[5]. He speaks of श्लेष, उत्प्रेक्षा, उपमा, दीपक, जाति[6]. He extols a prince as the source of fountain of the ambrosia, rasas of *Kāvyas*[7]. Thus by 600 A.C. we find

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[1] भावज्ञानेन हावेन चातुर्याद्रूपसम्पदा (IV 12 Vide Nāṭyashāstra 20.8.10 for भाव and हाव)

[2] प्रत्यक्षरश्लेषमयप्रबन्धविन्यासवैदग्ध्यनिधिर्निबन्धम् ।

[3] 'अग्रहेणापि काव्यजीवज्ञेन' p. 129 'सत्कविकाव्यबन्धइवानवबद्धतुहिनिपातः' p. 158 दीर्घोच्छवासरचनाकुलंसुश्लेषवक्त्रघटनापटुसत्काव्यविरचनमिव' (p. 238, Srirangam edition) (p. 140).

[4] (P. 140)

[5] उच्छ्वासान्तेप्यखिन्नास्ते येषां वक्त्रे सरस्वती । कथमाख्यायिकाकारा etc in हर्षचरित ।

[6] हरन्ति कं नोज्ज्वलदीपकोपमैः in कादम्बरी and श्लेषप्रायमुदीच्येषु in हर्षचरित ।

[7] 'आगमकाव्यामृतरसानाम् Kādambari I paragraph.

that numerous figures had been defined, rules had been laid down for the guidence of poets and various classes of composition such as कथा and अख्यायिका had distinctive forms. Works dealing with poetics are extant that were composed about the time of Bana ; such as (those of Bhāmaha and Dandin).

The earliar works on poetics are generally designated *Kāvyālankāra* e.g. the works of Bhāmaha, Vāmana and Rudrata. These works were so called probably, because *Alankāra* played the most prominent part in the treatment of poetics in them (following the maxim प्राधान्येन व्यपदेशा भवन्ति). Vāmana in his '*Kāvyalankāra Sūtra*' tells us that the word *Alahkāra* is used in two senses viz a thing of beauty and a figure of speech[1]. According to him it follows that a work on poetics is called Kāvyālankāra, because it points out and explains the things of beauty in Kāvya, makes us prize the later[2]. This is more or less scholarstic. Even in those early works, that are not designated as *Alānkāra* : figure of speech loom very large as in the Kāvyadarsha of Dandin, three fourth of which are taken up by the explanation and elucidation of figure of speech (of *Shabda* and *Artha*).

Another name for poetics is *Sāhitya*. This word seems to have been used in early works in three different but allied senses, though in modern times, it is generally employed for poetics. In the verse साहित्य संगीतकलाविहीनः' the word *Sāhitya* appears to have been used in the sense of *Kāvya*. In the verse 'साहित्यपाथोनिधिमन्थनोत्थं, कर्णामृतंरक्षत हे कवीन्द्राः' (विल्हण-विक्रमांक । II) it will be noticed that *Sāhitya* means 'literature in general, and *Kāvya* is said to arise like nector from the ocean of *Sāhitya*. Pratīhārendurāja in enlogising his teacher Mukula and his proficiency in the *Mimansa* and other *shastra* speaks of him as 'साहित्य श्री मुरारेः' Here obviously the word *Sāhitya* stands for साहित्य शास्त्र

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[1] 'अलंक्रियते अनेन'

[2] 'काव्यं ग्राह्यमलंकारात् 'सौन्दर्यमलंकारः' काव्यालंकार (1-1-12) वृत्ति—अलंकृतिरलंकारः । करणव्युत्पत्त्या पुनरलंकार शब्दोयमुपमादिषु वर्त्तते । (काव्यालंकार सूत्रवृत्तिः)

Mukula, in the explanation of the *Kārīka*, remarks[1] the above and says 'पंचमी साहित्य विधेति' यायावरीयः। सा हि चतसृणामपि विधानां निष्यन्दः। Mankhaka remarks that विना न साहित्यविदाऽपरत्रगुणः कथञ्चितप्रथतेकत्रीनाम्'– श्री कण्ठ II 12.

These passages establish that sometime before 900 A.C. (when Rājshekhar flourished) the word '*Sāhitya*' came to be used in the sense of the science of poetics'. The word *Sāhitya* seems to be derived from सहित 'meaning together' when poetry came to be defined as 'शब्दार्थौसहितौकाव्यम्', the science of poetic criticism that propounded this definition was naturally called *Sāhitya*. Rajshekhara gives this etymology 'शब्दार्थयोर्यथा-वत्सहभावेन विद्या साहित्यविद्या' (काव्यमीमांसा P. 5). Similarly the Vyakti Viveka Tikā (p. 36) remarks the following.[2] Bhamaha says 'शब्दार्थौसहितौ काव्यम्' (1-10) and the Vakrokti Jīvit (P. L. XXX above) does the same. The Shishupālavadha says the following[3]. Therefore the use of the word *Sāhitya* arose probably after the 7th or 8th century.

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[1] (a) "पदवाक्यप्रमाणेषु तदेतत्प्रतिबिम्बतम्। यो यो जयति साहित्ये तस्य वाणी प्रसीदति। (अभिधावृत्तिमातृका p. 21)"

(b) 'व्याकरणमीमांसातर्कसाहित्यात्मकेषुचतुर्षुशास्त्रेषूपदोगात्'

[2] "न च काव्ये शास्त्रादिवदर्थं प्रतीत्यर्थं शब्द—Rājshekhara, p. 4). मात्रं प्रयुज्यते सहितयोः शब्दार्थयोस्तत्र प्रयोगात्। साहित्यं तुल्यकक्षत्वेनान्यूनातिरिक्तत्वम्।"

[3] शब्दार्थौ सत्कविखिद्वयं विद्वानपेक्षेते।" (II 86).

अलबीरूनी[1] का भारत आगमन

जयशंकर मिश्र

भारत के प्राचीन इतिहास में जो स्थान फाहियान, ह्वेनसांग आदि चीनी यात्रियों का है, वही स्थान भारत के मध्यकालीन इतिहास में अरबी यात्री अलबीरूनी का है। अलबीरूनी अपने समय का सर्वश्रेष्ठ चिन्तक और विद्वान था। वह यूनानी, अरबी, संस्कृत आदि भाषाओं का पूर्ण पण्डित और मर्मज्ञ था। एक-दो वर्ष तक उसने भारत की यात्रा भी की थी। भारत में उसने दो वर्ष से अधिक नहीं व्यतीत किये। अतः ईलियटकी यह धारणा कि अलबीरूनी ने भारतवर्ष में ४० वर्ष व्यतीत किए,[२] नवीन प्रमाणों के आधार पर भ्रांत साबित होती है। भारतीय धर्म-दर्शन, ज्योतिष-गणित, स्मृति पुराण, आचार-विचार, कला-संस्कृति आदि की अलबीरूनी द्वारा गंभीर और विशद व्याख्या देखकर ही ईलियट ने यह अनुमान कर लिया होगा कि अलबीरूनी भारत ४० वर्षों तक रहा। फलतः बाद के इतिहास-शोधकों ने ऐसी कल्पनाओं को भ्रांत मानकर अपनी टिप्पणियां प्रकाशित कीं। ईलियट द्वारा प्रस्तुत इतिवृत्तों की आलोचना करते हुए होदीवाला ने लिखा है कि अलबीरूनी के भारत-निवास की अवधि १३ वर्ष से अधिक नहीं हो सकती[३]। अपने कथन के समर्थन में होदीवाला ने सचाऊ के आधार पर ऐतिहासिक साक्ष्य उपस्थित किए हैं। सन् १०१७ ई० में खीवा के शासक को पराजित कर महमूद ग़ज़नी अलबीरूनी को अपने साथ गजनी ले गया, यह निर्विवाद है। इस प्रकार १०१७ ई० के बाद ही अलबीरूनी का भारत आना संभव प्रतीत होता है। साथ ही १०३० ई० में महमूद की मृत्यु के समय गजनी में अलबीरूनी का उपस्थित रहना भी बताया जाता है। परिणामतः १०१७ ई० में खीवा पर किए गए आक्रमण के समय से लेकर सन् १०३० अर्थात् महमूद गजनी की मृत्यु पर्यन्त कुल १३ वर्ष तक का काल ऐसा है जिसमें भारत में उसका रहना संभव हो सकता है। इसी आधार पर होदीवाला ने उसका भारत निवास-काल निश्चित किया है। किंतु अलबीरूनी

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[1] साधारणतः लोग 'अलबरूनी' या 'अलबेरूनी' लिखते हैं, किंतु 'अलबीरूनी' उच्चारण होना चाहिए।

[२] क "अबुरिहां ट्रैवेल्ड इन्टु इंडिया ऐंड—स्टेड फोर्टी इयर्स देयर" ईलियट हिस्ट्री आव इंडिया-ऐज़ टोल्ड बाइ इट्स ओन हिस्टोरियन्स, भाग २, पृ० २-३।

ख "बरूनी भारत में लगभग चालीस वर्ष रहे"—हिंदी विश्वकोश, नागरी प्रचारिणी सभा, काशी, पृ० २४३, १९६० ई०।

[३] "इट्स ड्युरेशन कुडनाट हैव इक्सीड थर्टीन इयर्स" होदीवालाः स्टडीज इन इंडो-मुस्लिम हिस्ट्री, पृ० १३२, १९३४।

नोट—('हिंदी विश्वकोश में 'अलबरूनी' पर लिखनवाले विद्वान लेखक डा० बैजनाथपुरी (ल० वि० वि०) द्वारा भी प्रमादवश ईलियट जैसी कल्पना की पुनरावृत्ति की गई है। उन्होंने ईलियट की पंक्तियों का अक्षरशः अनुवाद किया है,।

के ग्रंथ का अध्ययन-मनन एवं अनुसंधान-संधान करने पर यह प्रमाण पुष्ट नहीं प्रतीत होता। मेरे विचार से जैसा मैंने इस निबंध में, अलबीरूनी के कथनों के आधार पर प्रमाणित किया है, भारत में उसका प्रवास काल १०२७-२८ और १०२८-२९ के बीच अधिक से अधिक दो वर्षों का था।

यह संभव नहीं कि अलबीरूनी १०१७ ई० में तत्काल गजनी से भारत के लिए प्रस्थित हो गया हो अथवा १०१८ ई० में भारत पर होने वाले महमूद के अभियान में साथ रहा हो। यदि अलबीरूनी प्रसिद्ध योद्धा होता तो यह माना जा सकता था पर वह विद्वान और लेखक था जिसे अनुकूल वातावरण युद्ध क्षत्र में किसी तरह प्राप्त नहीं हो सकता था। सन् १०१७ ई० में गजनी पहुंचने पर अलबीरूनी का फिरदौसी, अनसरी, अलउत्बी आदि विद्वानों और साहित्यकारों से संपर्क हुआ। उस वातावरण में उसका मन रमा। वह महमूद के अभियानों में भारत आया होता तो अन्य बातों के समान इसका उल्लेख भी 'तारीख-उल-हिंद' में अवश्य करता। किन्तु उसने कहीं भी ऐसा उल्लेख नहीं किया है।

अलबीरूनी का जन्म मध्य एशिया, तुर्किस्तान, के खीवा नगर में ४ दिसंबर ९७३ ई० (धुल-हिजज मास हिजरी सन् ३६२) में हुआ[१] और देहांत १३ दिसंबर १०४८ ई० (३ रजब ४४० हिजरी) में[२]। इस प्रकार अलबीरूनी का जीवन-काल ७५ वर्षों का ठहरता है। ४० वर्ष की अवस्था (सन् १०१७ ई०) में वह गजनी पहुंचता है और यदि वह भारत आया होगा तो इसके बाद ही। गजनी पहुंचने के बाद उसका भारत-आगमन मान

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[१] ईलियट ने ९७०-७१ ई० (३६० हि०) दिया है ('हिंदी विश्वकोश में यही अनूदित है)। अधिकांश विद्वान् ९७३ ई० मानते हैं—
क—सचाऊ : अलबीरूनीज इंडिया, पृ० ८, १९१०।
ख—वरनी : अलबीरूनी, दि० सं०, १९२६।
ग—वी० कोर्ट्वायस-अलबीरूनी, पृ० ९, १९५२। च—एम० ए० काजिम, वही, पृ० १६१।
घ—अलबीरूनीज कमेमोरेशन वाल्यूम् : इंट्रोडक्शन, पृ० १४, १९५२।
ङ—सुनीति कुमार चटर्जी : अलबीरूनी एंड संस्कृत, वही पृ० ८३।

[२] ईलियट ने मृत्यु ई० १०३८-३९ दी है ('हिंदी विश्वकोश' में इसी का अनुवाद है)। अधिकांश विद्वान १०४८ ई० को ही अलबीरूनी की मृत्यु काल मानते हैं—
सचाऊ, वही, पृ० २४;
वी० कोर्ट्वायस, वही, पृ० १५;
अलबीरूनीज कमेमोरेशन वाल्यूम, इंट्रोडक्शन, पृ० १४;
एम० ए० काजिम, वही;
सुनीति कुमार चटर्जी, वही।
क—मेक्समेयर होप ने अलबीरूनी का मृत्युकाल १०५० ई० माना है—आई० एस० आई० एस०, वा ३७, पृ० ३२, १९४७।
ख—जेंकी वालिदी तोगान भी मेयरहोप के मत को ही मानते हैं—'बीरूनीज पिक्चर आव द वर्ल्ड', पृ० ५।

लेने पर भारत में ४० वर्ष तक अलबीरूनी का प्रवास प्रमाणित नहीं हो सकता। कारण, यदि उसका ४० वर्ष का भारत-प्रवास-काल मान लिया जाय तो मानना होगा कि वह सबसे पहले सन् १००८ ई० में भारत आया जो किसी प्रकार संभव नहीं है क्योंकि महमूद गजनी से १०१७ ई० में मिलने से पहले वह खीवा से थोड़े समय के गरगंज गया था, भारत के लिये नहीं।

होदीवाला के मत के अनुसार अब रही उसके १३ वर्ष के भारत-प्रवास की बात। यह एतिहासिक सत्य है कि १०१७ ई० से लेकर अंतिम काल तक वह गजनी के आश्रय में रहा। उसकी लेखनी से यह स्पष्ट है कि वह महमूद की मृत्यु के समय (१०३० ई० में) गजनी में उपस्थित था। इसका उल्लेख मिलता है कि १०३० ई० से लेकर मृत्यु पर्यन्त समय उसने गजनी में ही व्यतीत किया। ऐसी अवस्था में उनका भारत में १३ वर्ष रहना या व्यतीत करना भी अनुमानाश्रित ही कहा जा सकता है। जो व्यक्ति अपनी पुस्तक 'तारीख-उल-हिंद' में एक-एक व्यक्ति के साथ हुई मुलाकात तक की बात लिखता हो, अपनी जानकारी के स्रोतों का उल्लेख करता हो, कब-कब क्या-क्या लिख रहा था यह स्पष्ट बतलाता हो, भारत में अपने रहने-घूमने के स्थानों का वर्णन करता हो, वह अपने भारत में रहने की तिथि न लिखे यह आश्चर्य ही है। यहां अलबीरूनी के संपूर्ण जीवन और उसके कार्य-व्यापार से सारी वस्तु-स्थिति स्पष्ट की गई है।

अलबीरूनी प्रारंभिक अवस्था से ही अध्ययनशील था। खीवा (ख्वारिज्म) से ४ फरसख उत्तर गरगंज[१] के शासक ने ९९४-९५ ई० में स्वतंत्रता की घोषणा कर दी, जो समानी राज्यांतर्गत था। अलबीरूनी परिस्थितिवश गरगंज के शासक के आश्रय में चला गया, उस समय उसकी अवस्था २३ वर्ष की थी[२]। वहां उसने कई पुस्तकें लिखीं। उसने 'अतहर-अल-वाकिया' नामक पुस्तक गरगंज के शासक वाशमगीर के पुत्र काबूस को समर्पित की। मुस्लिम इतिहास बतलाता है कि गरगंज उस समय विद्या और सभ्यता के क्षे में अग्रगण्य था[3]। अलबीरूनी ने वहां रहते हुए गणित-भूगोल आदि विषयों का ज्ञान अर्जित किया।

गरगंज से १००९ ई० में वह खारिज्म लौट आया।[४] विद्या और बुद्धि में उसकी प्रसिद्धि ऐसी फैली कि वह राजदरबार में वजीर बना दिया गया। १०१७ ई० में महमूद गजनी ने खीवा को विजित किया। फलतः 'शाह-ए-खारिज्म'[५] नामक उपाधि उसने धारण की और वहाँ के दरबारी विद्वानों को अपने साथ गजनी लेता गया। महमूद गजनी देश, धन तो लूट ही लेता था, विद्वान जनों को भी अपने यहाँ ले जाता था। विद्यापारखी महमूद अलबीरूनी ऐसे विद्वान को कैसे छोड़ सकता था। वह अलबीरूनी को भी अपने

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[१] इस स्थान को अरब वाले जुर्जानिया कहते थे और परवर्ती मंगलो और तुर्क 'अरजन्ध'।

[२] वी० कोर्ट्वायसः अलबीरूनी, पृ० १०।

[३] डव्ल्यू० बरहोल्डः तुर्किस्तान, पृ० १४७।

[४] संतरामः अलबेरूनी का भारत (अनुवाद), भा० २, पृ० ४, १९१२।

[५] निजामुद्दीन अहमदः तबकात अकबरी (अंग्रेजी अनु० वी० डे, पृ० ९, १९१३)।

गजनी दरबार की शोभा बढ़ाने के लिए लेता गया। १०१७ ई० के बाद अलबीरुनी शेष जीवन पर्यन्त गजनी के आश्रय में रहा।[1] लिखने-पढ़ने में ही वह बराबर लगा रहा।

अलबीरूनी गजनी पहुँच कर भारतीय साहित्य और संस्कृति के संपर्क में आया। यद्यपि इसके पहले से वह भारतीय विषयों की जानकारी रखता था, कई भारतीय पुस्तकों के अनुवाद भी कर चुका था, तथापि गजनी आकर वह भारतीय विद्याओं के निकट संपर्क में आया। सम्राट महमूद द्वारा भारत से गजनी ले जाए गए हिन्दू विद्वानों के संसर्ग से उसने भारतीय ज्योतिष, गणित, भूगोल, रसायनशास्त्र, धर्मशास्त्र, दर्शन आदि का ज्ञान प्राप्त किया। इतना ही नहीं शांतिपूर्वक भारतीय विद्याओं का अध्ययन-अनुशीलन किया।

अलबीरूनी के हृदय में भारतीय ज्ञान के प्रति प्रबल पिपासा थी। वह भारत सम्वन्धी समस्त उपलब्ध ग्रन्थों का अध्ययन करता था। जो ग्रन्थ उसे सुलभ न होते थे उनको स्वयं धन व्यय करके मँगवाता था, पढ़ता था और ग्रन्थ लेखन में उनका उपयोग करता था। जो ग्रन्थ उसकी समझ में नहीं आते थे उन्हें सुदूरवर्ती हिन्दू विद्वानों की सहायता से पढ़ने में कोई प्रयत्न उठा न रखता था। उन्हें बुलाता था अथवा स्वयं उनके पास जाता था। वह 'तारीख-उल-हिन्द' पुस्तक के प्रथम परिच्छेद में लिखता है—

"जिन स्थानों से मुझे संस्कृत ग्रन्थों के मिल सकने की संभावना होती है, वहाँ से उन्हें इकट्ठा करने और उन पुस्तकों को समझने और मुझे समझा सकने वाले सुदूर देश के निवासी हिन्दू विद्वानों की सहायता लेने के लिए धन व्यय करने और कष्ट सहन करने में मैं कुछ उठा नहीं रखता[2]।"

यही ज्ञान पिपासा उसे भारत ले आई यह निर्विवाद है। स्वदेश में (गजनी में) भी भारतीय दर्शन और संस्कृत पर जो चर्चाएँ चलती थीं, उसमें वह सम्मिलित होता था। वह स्वयं लिखता है—

"हमारी बात को स्पष्ट करने के लिए उपस्थित लोगों में से एक ने उदाहरणार्थ हिन्दुओं के मतों और सिद्धान्तों की चर्चा चलाई[3]।"

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[1] क—सचाऊ: अलबीरूनीज इंडिया, भू० पृ० ९, १९१०।
ख—बी० कोर्ट्वायस: अलबीरूनी, पृ० १२।

[2] "आई डू नाट स्पेयर आइदर ट्रबुल आर मनी इन् कलेक्टिंग संस्कृत बुक्स फ्राम प्लेस ह्वेयर सपोज्ड दे वेयर लाइक्ली टु बी फाउन्ड, ऐंड इन् प्रोक्युरिंग फार माईसेल्फ, इवेन फ्राम इवरी रिमोट प्लेसेज, हिन्दू स्कालर्स हू अन्डरस्टैंड देम ऐंड आर एबुल टु टीच मी।'
— अलबीरूनी : वही, पृ० १२।
सचाऊ, वही, भाग १, पृ० २४।

[3] "इन आर्डर टु इलस्ट्रेट द प्वाइंट आव आवर कनवरसेशन, वन आव दोज प्रेजेन्ट रिफर्ड टु द रिलीजन्स ऐंड डाक्ट्रिन्स अव द हिन्दुज बाई वे आव ऐन इक्जाम्पुल।"
—अलबीरूनी, वही, पृ० ३१।
सचाऊ, वही, भाग २, पृ० २५२।

उसके उक्त कथन से यह विदित होता है कि उसके समय में तथा उसके पहले से भारतीय सिद्धान्तों और दर्शनों पर चर्चाएँ चलती थीं, और अलबीरूनी भारतीय विषयों पर अपने समय में चलनेवाली चर्चाओं में भाग लेता था।

सुदूर स्थानों में भारतीय धर्म और दर्शन, सभ्यता और संस्कृति, साहित्य और कला की प्रसिद्धि कितनी फैल चुकी थी इसका अन्दाज अलबीरूनी के इस कथन से लगाया जा सकता है कि अलेरान शहरी[1] आदि अरबी विद्वानों ने अपनी धार्मिक और दार्शनिक कृतियों में स्थान-स्थान पर इनके उद्धरण दिए हैं।

'तहरीर (या तहकीक) मा लिल-हिन्द मिन मकाल मकबूल फि-ल-अवल अव मरधूल'[2]

अलबीरूनी भारतीय ग्रन्थों को पढ़ने से तथा हिन्दू विद्वानों के संसर्ग से भारतीय विद्याओं को जितना कुछ आत्मसात कर सका था उतना वह भारत सम्बन्धी एक पुस्तक में लिपिबद्ध कर देना चाहता था। इसके लिए उसके गुरु अबू सहल ने उसे प्रेरित किया था। अबु सहल महमूद के मन्त्रियों में से था, जो अरबी और भारतीय विद्याओं का पण्डित था[3]। अलबीरूनी लिखता है—

"गुरूजी को प्रसन्न करने के लिए मैंने हिन्दुओं के सिद्धान्तों पर यह पुस्तक लिखी[4]।" वहस्वयं कहता है—

"जो कुछ मुझे हिन्दुओं के विषय में ज्ञात है उसे लिख दूं, ताकि जो लोग उनसे धार्मिक विषयों पर शास्त्रार्थ करना चाहें उन्हें इससे सहायता मिले और जो लोग उनसे मेल-मिलाप करना चाहें उन्हें यह ज्ञान-भंडार का काम दे[5]।"

अलबीरूनी के उत्तर उद्धरण से विदित होता है कि उसके यहाँ (गजनी में) भारतीय विषयों पर शास्त्रार्थ हुआ करते थे। अधिकांश पढ़े-लिखे लोग भारतीय विषयों की

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[1] अलबीरूनी, वही।
सचाऊ, वही भाग २, पृ. २५२।

[2] इस पुस्तक को सर्वप्रथम जर्मन विद्वान सचाऊ (या सखाऊ) ने विद्वत्तापूर्ण भूमिका के साथ सर्वप्रथम जर्मन भाषा में और १८८७ ई० में अंग्रेजी में अनूदित किया।

[3] सचाऊ, वही, भा० २, पृ० २५०-५१।

[4] "इन आर्डर टु प्लीज हिम-हैव डन सो, ऐंड रीटेन दिस बुक आन द डाक्ट्रिन्स आव द हिन्दूज।"

—अलबीरूनी, वही, पृ० ४।
सचाऊ, वही, भा० १, पृ० ७।

[5] "ह्वाट आई नो एबाउट द हिन्दूज ऐंज ए हेल्प टु दोज हू वान्ट टु डिसकस रिलीजियस क्वेश्चन्स विथ देम, ऐंड ऐंज ए रिपर्टरी आव इन्फार्मेशन टु दोज हू वान्ट टु असोसिएट विथ देम।"

—अलबीरूनी, वही, पृ० ४।
सचाऊ, वही।

जानकारी रखते थे। उसके पूर्व भी, भारतीय सभ्यता और दर्शन का महत्व उसके यहाँ बहुत बढ़ा-चढ़ा था, जिससे प्रभावित होकर उसने भारतीय सिद्धान्तों और दर्शनों का ज्ञान प्राप्त कर 'तहरीर (या तहकीक) मा लिल-हिन्द मिन मकाल मकबूर फि-ल-अवल अव मरधूल' नामक पुस्तक का प्रणयन किया। छोटे शीर्षक में इसे 'तारीख-उल-हिंद' भी कहते हैं।

अलबीरूनी ने 'तारीख-उल-हिंद' का अधिकांश गजनी में रहकर लिखा। बहुत कम अंश उसने गजनी के बाहर लिखा। प्रथम परिच्छेद में वह लिखता है—

"अमीनुद्दौला महमूद **तीस या तीस से अधिक वर्षों तक भारत पर अभियान** करता रहा। महमूद ने भारत (देश के) ऐश्वर्य को सर्वथा नष्ट कर दिया **वहाँ** उसने अपना अद्भुत पराक्रम दिखलाया जिससे सर्वत्र हिंदू धूल की तरह उड़ गए[1]।"

उसके उपर्युक्त उद्धरण से यह सिद्ध होता है कि वह जिस समय अपनी पुस्तक 'तारीख-उल-हिंद' का पहला परिच्छेद लिख रहा था उस समय तक महमूद भारत पर अपना संपूर्ण अभियान—**'तीस या तीस से भी अधिक वर्षो तक'** का समाप्त कर चुका था। **'भारत पर'** और **'वहाँ'** शब्दों से यह व्यंजित एवं लक्षित होता है कि अलबीरूनी अपने यहाँ अर्थात् गजनी में पुस्तक का पहला परिच्छेद लिख रहा था। अगर उसने भारत में लिखा होता तो **'यहाँ'** शब्द का व्यवहार करता। साथ ही उसके उक्त कथन से यह भी विदित होता है उसने 'प्रस्तावना और प्रथम परिच्छेद' पुस्तक समाप्त हो जाने के बाद लिखी। क्योंकि पुस्तक में उसने सोमनाथ संबन्धी बात को छोड़कर और कहीं यह नहीं लिखा है कि महमूद भारत में तीस साल से भी अधिक आक्रमण करता रहा। उसके इस कथन से यह भी स्पष्ट होता है कि महमूद का जीवन-काल समाप्त हो चुका था, जिसमें उसने तीस साल से भी अधिक काल भारत पर अनेक बार आक्रमाण करने में बिताए। महमूद तीस[2] वर्ष की अवस्था में गजनी का शासक हुआ और तिरसठ[3] वर्ष की अवस्था में मृत्यु को प्राप्त हुआ। कुल तेंतीस वर्ष वह गजनी का शासक रहा, जिसमें केवल भारत पर आक्रमण करने में उसने तीस से भी अधिक वर्ष व्यतीत किए।

ग्यारहवें परिच्छेद के एक उल्लेख से विदित होता है कि अलबीरूनी गजनी प्रदेश के बाहर १०२७ ई० के बाद "तारीख उल-हिंद" पुस्तक के कुछ परिच्छेद लिख रहा था—

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[1] "यामिनीऊद्दौला महमूद मार्च्ड इन्टु इंडिया ड्यूरिंग ए पीरियड आव थर्टी इयर्स ऐंड मोर—महमूद अटर्ली रुइन्ड द प्रास्परिटी आव द कंट्री, ऐंड परफार्म्ड दीज वन्डरफुल इक्स्प्लवायट्स, बट ह्विच द हिंदूज बिकेम लाइक ऐटम्स आव डस्ट स्कैटर्ड इन आल डाइरेक्शन्स।"

—अलबीरूनी, वही, पृ० ११।

सचाऊ, वही, भा० १, पृ २२।

[2] मुहम्मद हबीबः सुल्तान महमूद अवगजनी, द्वि० सं०, पृ० ६०, १९५१

[3] वही, पृ० १८।

"थानेश्वर नगर के प्रति हिन्दुओं के हृदय में असीम श्रद्धा है। वहाँ की मूर्ति का नाम चक्रस्वामिन है—यह मूर्ति पीतल की है और लगभग मनुष्य के कद की है। संप्रति यह भगवान सोमनाथ के साथ **गजनी नगर** के घुड़दौड़ के मैदान में पड़ी है।[1]

अलबीरूनी का यह कथन कई ऐतिहासिक वृत्तों पर प्रकाश डालता है—

प्रथम यह कि स्थानेश्वर के चक्रस्वामिन की मूर्ति, जिसे महमूद ने भारत पर किए जाने वाले छठे अभियान में १०११ ई० में तोड़ी थी, गजनी के घुड़दौड़ के मैदान में फिकवा दी और बाद में उसने जब भारत प्रसिद्ध बारहवें अभियान में सोमनाथ की मूर्ति खंडित की तब उसे भी उसने चक्रस्वामिन की मूर्ति के साथ घुड़दौड़ के मैदान में धरवा दी। पहली घटना अलबीरूनी के अनुपस्थिति काल में घटी जब वह स्वदेश में था और दूसरी घटना उसकी मौजूदगी में, गजन-वास के ८-९ वर्ष बाद। उसने उन खंडित मूर्तियों को गजन के घुड़दौड़ के मैदान में पद्दलित होते देखा था, और जब वह मूर्ति संबंधी तत्तत् प्रसंग पर लिखने लगा, तब उसने जो देखा था लिख दिया। सोमनाथ की मूर्ति १०२६ ई० में ही गजन गई जब महमूद भारत से गजन लौटा[2]। अतः अलबीरूनी के उद्धरण से प्रमाणित है कि वह १०२७ ई० तक गजन अवश्य था। इसके बाद ही भारत आया।

द्वितीय यह कि, "यह मूर्ति पीतल की है और लगभग मनुष्य के कद की है" वाक्य से स्पष्ट होता है कि उसने स्वयं उस मूर्ति को देखी थी। **"गजनी नगर"** के संकेत से प्रकट होता है कि वह गजनी में नहीं था, अगर वह गजनी में होता तो "इस समय" की तरह **"इस जगह"** का भी प्रयोग करता। अतः सिद्ध है कि अलबीरून १०२७–२८ ई० में गजनी के बाहर किसी स्थान पर संभवतः भारत में अपनी पुस्तक का लेखन-कार्य कर रहा था। जैसा बताया जा चुका है कि उसने बीच के कुछ परिच्छेदों को पहले लिखना उचित समझा तथा प्रारंभ के दो-चार परिच्छेद उसने अंत में लिखने के लिये छोड़ रखे।

सत्रहवें परिच्छेद में वह लिखता है—

"वल्लभी नगरी के राजा वल्लभ के विषय में जिसके संवत् का वर्णन हमने किसी दूसरे परिच्छेद में किया है, हिंदू एक कथा सुनाते हैं[3]।"

"किसी दूसरे परिच्छेद" से साबित है कि उसने "तारीख-उल-हिंद" के परिच्छेदों को क्रम से नहीं लिखा, अगर उसने क्रम से लिखा होता तो निश्चय ही वह परिच्छेद का नाम यथास्थान निर्दिष्ट करता। यह स्पस्ट है कि पुस्तक के परिच्छेदों को सुविधा के अनुसार आगे-पीछे लिख रहा था।

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[1] "द सिटी आव तनेसर (थानेश्वर) इज हाइली वनरेटेड बाई द हिंदूज द आइडल आव दैट प्लेस इज काल्ड चक्रस्वामिन—इट इज आव ब्रान्ज, ऐंड इज नियर्ली द साइज आव मैन इट इज नाउ लाइंग इन द हिपोड्रम इन गजन, टुगेदर विथ द लार्ड आव सोमनाथ।"

अलबीरूनी, वही, पृ० ५६।

सचाऊ, वही, भा० १, पृ० ११७।

[2] ब्रिग्स, भा० १, पृ० ८३।

[3] अलबीरूनी, वही, पृ० ९४। सचाऊ, वही, भा० १।

इस प्रकार यह निश्चय हो जाता है कि ११वाँ परिच्छेद तथा कुछ अन्य परिच्छेद उसने गजनी के बाहर लिखे।

अलबीरूनी का भारत आगमन कब हुआ, किसके साथ हुआ, इसमें लोगों के विभिन्न अनुमान हैं। कुछ लोगों का कहना है कि वह महमूद के भारत-अभियान में साथ रहा[1] और कुछ लोगों का कहना है कि वह महमूद द्वारा भारत में निर्वासित कर दिया गया था[2]। किंतु ये मत कल्पना-प्रसूत हैं। जैसा मैंने ऊपर अन्य शीर्षकों के अन्तर्गत यह प्रमाणित किया है कि अगर वह महमूद के साथ भारत आया होता अथवा महमूद द्वारा निष्कासित कर दिया गया होता तो वह निस्संदेह अपनी "तारीख-उल-हिंद" पुस्तक में कहीं-न-कहीं किसी-न-किसी रूप में अन्य तथ्यों की तरह इस तथ्य का उल्लेख अवश्य करता तथा अपनी उक्त पुस्तक में स्थान-स्थान पर महमूद को आदरसूचक शब्दों से न स्मरण करता।[3]

अलबीरूनी के कथनों से स्पष्ट है कि उसने अपनी पुस्तक का समापन गजनी में ही किया। यद्यपि पुस्तक के हस्तलेख पर अरबी में लिखे एक नोट से यह विदित होता है कि अलबीरूनी ने १ ली मुहर्रम ४२३ हिजरी अर्थात् २९ दिसम्बर १०३१ ई० के दिन गजनी में पुस्तक समाप्त की। महमूद गजनी की मृत्यु के बाद गजनी में बैठकर अपनी पुस्तक का जो ४९वाँ परिच्छेद उसने लिखा है उसमें उसने महमूद गजनी को इस्लाम धर्म का स्तंभ और उसकी मृत्यु को संसार की आश्चर्यजनक घटना बतलाया है।

"शेरे-दुनिया बादशाह महमूद ऐसे सरंक्षक का गत होना, सर्वाधिक सुदृढ़ स्तंभ का ढहना, **यह अपने समय की** आश्चर्यजनक घटना है। अल्लाह उसकी खैर करे। **यह घटना एक वर्ष के भीतर ही घटित हुई।** अतः यह समय स्मरणीय है[4]।"

उसके उक्त उल्लेख से यह स्पष्ट उद्भासित होता है कि मदमूद की मृत्यु के एक-दो वर्ष पहले, संभवतः १०२८–२९ ई० में गजनी पहुँच कर अलबीरूनी अपनी पुस्तक की समाप्ति में लग गया। **"यह अपने समय की", "यह घटना", "यह समय"** आदि शब्दों से यह प्रकट होता है कि वह गजनी में वर्तमान था। वह अपने आश्रयदाता महमूद की आँख से दूर नहीं रह सकता था।

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[1] एन० एस० बोस, हिस्ट्री आव द चंदेलाज, पृ० १२, १९५६।

[2] मुहुम्मद हबीब, सुल्तान महमूद गजनी, पृ० ६८।

[3] अलबरूनी, वही, पृ० २०८, २५२, २०३ (आदि)।
सचाऊ, वही, भा० २, पृ० १३, (आदि)।

[4] "इट इज मेमोरेबुल टाइम, फार द ब्रेकिंग आव द स्ट्रांगेस्ट पिलर आव द रिलिजन, द डसीज आव द पैटर्न आव ए प्रिंस महमूद द लायन् आव वर्ल्ड, द वन्डर आव हिज टाइम-मे गाड हैव मर्सी अपान हिम-टुक प्लेस वनली ए शार्ट टाइम, लैस दैन ए इयर, बिफोर इट।"

—अलबीरनी, वही, पृ० २०३।
सचाऊ, वही भा० २, पृ० २।

अलबीरूनी के प्रकीर्ण कथनों से स्पष्ट है कि वह १०२७–२८ ई० के बीच किसी समय भारत आया और एक-दो साल बाद १०२८–२९ में गजनी अवश्य चला गया। अतः उसका भारत में आवासकाल दो वर्षों से अधिक नही हो सकता।

भारत के उत्तरी हिस्सों पर लिखे गए अलबीरूनी के भौगोलिक वर्णन को देखकर विद्वान् इतिहासकारों ने यह धारणा बनाली कि उसने भारत के अनेक प्रान्तों का भ्रमण किया, किंतु अलबीरूनी के उल्लेखों से इसकी पुष्टि नहीं होती। भारत के, केवल पंजाब के, जिन-जिन स्थानों पर वह गया था, उनका उल्लेख उसने किया है। उत्तरी भारत के जिन-जिन स्थानों का भौगोलिक वर्णन किया है वह उसने पुराणों तथा लोगों से सुनी हुई बातों के आधार पर किया है। इन्हीं विवरणों से अधिकांश इतिहासकारों को यह भ्रम हो गया कि अलबीरूनी ने उत्तरी भारत के अनेक प्रांतों तथा स्थानों का भ्रमण किया था। ईलियट[1] द्वारा इस प्रकार का उल्लेख हुआ है और सचाऊ[2] ने भी ऐसा ही लिखा है। किंतु अलबीरूनी के निम्नलिखित विवरण यह मानने के लिए बाध्य करते हैं कि वह भारत के केवल पंजाब प्रदेश के कुछ चुने हुए स्थानों को छोड़ और किसी भी स्थान पर नहीं जा सका—

"इसके दक्षिण में राजगिरि का किला और इसके पश्चिम में लहुर का किला है। मैंने इनके जैसे सुदृढ़ स्थान अब तक नहीं देखे[3]।"

"मैंने स्वयम् लहुर किले का अक्ष ३४° १०" 'मालूम किया है।—जो दूसरे अक्ष मैं स्वयम् मालूम कर सका हूँ उन्हें यहां बतलाता हूँ—

"गजन, काबुल, बादशाह की गार्द-चौक गन्दी, दुदपुर, लमगान, पुरशावर, वैहन्द, जैलम, नन्द (काकिला), सालकोट, मन्दककोर, मुलतान।"

"हम स्वयं भी उनके देश में उन स्थानों से आगे नहीं गए जिनका हमने उल्लेख किया है[4]।"

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[1] "सेवरल आव द प्राविन्सेज आव इंडिया वेयर विजिटेड बाई हिम"।

—इलियट, वही, पृ० २–३, १८६७।

"उन्होंने यहाँ कई प्रांतों का भ्रमण किया" ("हिंदी विश्वकोश" में ईलियट की पंक्तियों का अनुवाद)।

[2] "ही स्टेड इन डिफरेन्ट पार्टस आव इंडिया"

—सचाऊ वही, भू० पृ० १५।

[3] "द फोर्टेस राजगिरि लाइज साउथ आव इट, ऐंड द फोर्टेस लहुर वेस्ट आव इट, द स्ट्रांगेस्ट प्लेसेज आई हैव इवेन शीन।"

—अलबीरूनी, वही, पृ० १०२।

सचाऊ, वही, भा० १, पृ० २०८।

[4] आई माइसेल्फ हैव फाउंड द लैटीच्यूड आव दा फोर्ट्रेस लहुर टु बीव ३४° १०' ह्वाट अदर लैटीच्यूड्स आई हैव बीन एवुल टु आवसर्व माइसेल्फ शैल इन्युमरेट

ऊपर की स्वीकृति से यह स्पष्ट हो जाता है कि उपरिलिखित स्थानों के अतिरिक्त वह भारत के किसी अन्य स्थान पर नहीं गया अतः उसकी भारत के अन्य प्रदेशों में घूमने की जो बात कही जाती है, वह कथ्य है तथ्य नहीं।

जिन-जिन स्थानों पर वह गया, वहाँ के लिए लिखता है कि **'मैंने स्वयं देखा'** और जिन-जिन स्थानों पर नहीं गया वहाँ के लिए लिखता है कि लोगों ने **'मुझे बताया'**, **'सूचना दी'** आदि।

(क) 'तिलवत के संमुख दाईं ओर का देश नैपाल राज्य है। एक मनुष्य ने जो उन देशों का भ्रमण कर चुका था, मुझे निम्नलिखित **सूचना दी**[1]।"

(ख) "सोमनाथ के पड़ौस में रहने वाले एक व्यक्ति ने **मुझे बताया** कि हमारा मिसकल तुम्हारे मिसकल के बराबर है[2]।"

(ग) "मुझे कन्नौज देश के कुछ लोग मिले हैं, जिन्होंने **मुझे बताया है**[3]।"

अलबीरूनी के ऊपर के उद्धरणों से प्रकट है कि उसने भारत संबंधी अनेक बातें लोगों से सुनकर और समझकर लिखीं।

इतिहास की दृष्टि से अलबीरुनी का भारत आगमन, प्रवास और भ्रमण अत्याधिक महत्व का है। भारत संबंधी उसके विवरण पूर्व मध्यकालीन भारतीय इतिहास के प्रमुख स्रोत हैं। उसके विवरणों को पढ़कर किसी निश्चित तथ्य पर न पहुँच कर कुछ लोग अनुमान से उसके अनेक वर्षों तक भारत में रहने, घूमने आदि भी कल्पना कर लेते हैं। ऐसी कल्पनाएँ इतिहास की दृष्टि से अत्यन्त घातक हैं।

इतिहास की दृष्टि से अलबीरूनी का भारत आगमन, आवास और भ्रमण अत्यधिक महत्व का है। भारत सम्बन्धी उसके विवरण पूर्व मध्यकालीन भारतीय इतिहास के प्रमुख श्रोत हैं। उसके विवरणों को पढ़कर निश्चित तथ्य पर न पहुँच कर कुछ लोग अनुमान से उसके अनेक वर्षों तक भारत में रहने, घूमने आदि की कल्पना कर लेते है। ऐसी कल्पनायें इतिहास की दृष्टि से अत्यन्त घातक हैं।

दिस प्लेस गजन, काबुल, कन्दी द गार्ड-स्टेशन, आव द प्रिंस, दुवपुर, लमगान, पुरशावर, वैहंद, जेलम, द फोर्ट्रेस नंदन, शालकोट, मन्दककोर, मुल्तान।

वी आवर्सेल्व्स हैव (इन ट्रैवेल्स) इन द कन्ट्री नाट पास्ड बियांड द प्लेसेज ह्विच वी हैव मेंशन्ड। —अलबीरूनी, वही, पृ० १६२।
सचाऊ, वही भा० १, ३१७-१८।

[1] अलबीरूनी, वही, पृ० ९८।
सचाऊ, वही, भा० १, पृ० २०१।

[2] अलबीरूनी, वही, पृ० ७७।
सचाऊ, वही, भा० २।

[3] अलवीरूनी, वही, पृ० २६७।
सचाऊ, वही भा० २।

इस प्रकार ऊपर के विश्लेषण से यह स्पष्ट है कि अलबीरूनी का भारत में रहने का काल अधिक से अधिक दो वर्षों का (१०२७-२८ से १०२८-२९ के बीच) है। ४० वर्ष अथवा तेरह वर्ष कहना निराधार है। इसी प्रकार भारत के अनेक प्रांतों का भ्रमण करने की बात कहना भी पूर्णतः आधारहीन है। अलबीरूनी के 'तारीख-उल-हिंद' ग्रंथ का अनुशीलन-परिशीलन करने से नए तथ्य संमुख आते हैं तथा उसके विषय में अबतक जो मत व्यक्त किए गए हैं, वह उसके हीं कथन से निराधार और तथ्यहीन साबित होते हैं।

पृथ्वी की आन्तरिक रचना

कुमारी मधु, द्वितीय वर्ष (विज्ञान)

मनुष्य की जिज्ञासु प्रवृत्ति, विज्ञान का सोपान है। युगों से मानव मस्तिष्क में कैसे, क्यों, कब और क्या के प्रश्न उठते रहे हैं और इन्हीं गुत्थियों को सुलझाने में ही आज के सम्पूर्ण विज्ञान की प्रगति आधारित है। मानव के सतत प्रयासों और प्रयत्नों का ही यह परिणाम है कि वह अपने को पाषाण युग से आण्विक और स्पुटनिक युग में ले आया है। उसके लिए अंतरिक्ष यात्रा का स्वप्न भी अब सरल और साकार हो उठा है। रसायन, भौतिकी, भू-भौतिकी, भौमिकी, प्राणिकी, औद्भिदी आदि-आदि अनेकों वैज्ञानिक विषयों पर होने वाले अन्वेषण, क्या मनुष्य के उल्लेखनीय एवं ज्वलन्त कार्य्य नहीं समझे जा सकते? क्या वे इस बात के सूचक नहीं हैं कि आज का विज्ञान अपनी चरम सीमा की ओर पहुंच रहा है?

इन्हीं क्या और क्यों के प्रश्नों को लेकर मनुष्य चिरकाल से पृथ्वी की आंतरिक रचना तथा स्थिति के विषय में जिज्ञासु रहा है, जिसके परिणाम-स्वरूप उसको आधुनिक युग में आशातीत सफलता प्राप्त हुई है। पृथ्वी की आंतरिक जैसी जटिल समस्या को सुलझाने में वैज्ञानिकों को कतिपय कठिनाइयों का सामना करना पड़ा, जिनमें कि सबसे प्रमुख कठिनाई मनुष्य के केन्द्र तक न पहुंच सकने की है। अतः इस ओर हमारा जितना भी ज्ञान है वह सबका सब प्रत्यक्ष अवलोकनों की अपेक्षा अप्रत्यक्ष अवलोकनों पर ही आधारित है। प्रारम्भिक काल में जब कि पृथ्वी की आन्तरिक रचना का सविस्तार पता नहीं लग पाया था, वैज्ञानिकों की कई धारणायें थीं। कुछ का अनुमान था कि पृथ्वी की पर्पटी मात्र ही ठोस है जब कि उसका आन्तरिक भाग द्रव्यावस्था में है; कुछ का विचार था कि आन्तरिक भाग गैसीय अवस्था में है जबकि कतिपय लोग आन्तरिक भू को दोनों द्रव्य और गैसीय अवस्था में सोचे बैठे थे। परन्तु आधुनिक वर्षों में भौकम्पिकी (Scismology) विज्ञान ने इस दिशा के हमारे भ्रमों को दूर कर दिया है और बहुत कुछ अंशों में पृथ्वी के आन्तरिक की वास्तविक रचना का रहस्योद्घाटन कर दिया है जिसके कि बल पर हम आज इस विषय में बहुत कुछ लिख व बोल सकते हैं।

हमारी पृथ्वी का आकार बहुत कुछ नारंगी के समान है जिसका कि अर्धव्यास लगभग ४००० मील (६००० किलोमीटर के लगभग) है। वैज्ञानिकों ने यह निश्चित रूपेण पता लगा लिया है कि भूतल से केन्द्र की ओर जाने पर आपेक्षित घनत्व, ताप और दबाव प्रत्येक में क्रमशः वृद्धि होती है। पृथ्वी के घनत्व से सम्बन्धित गणनों के अनुसार उसका माध्य घनत्व लगभग ५·५ के आता है जबकि उसकी तल पर की शिलाओं का घनत्व २·७ है। अतः हमारी यह धारणा कि पृथ्वी के आन्तरिक केन्द्रीय भाग का घनत्व ५·५ से अधिक होना चाहिये बिलकुल सही है। ऐसा अनुमान है कि केन्द्रीय भाग धात्वीय आन्तरक का है जिसका कि आपेक्षित घनत्व लगभग १२ के है।

ज्वालामुखी पर्वतों, ऊष्ण-उत्सों आदि को देख करके पृथ्वी के आन्तरिक ताप के सम्बन्ध में हम कह सकते हैं कि पृथ्वी के अन्दर का ताप भू-तल की अपेक्षा कहीं अधिक है। जिन

लोगों को खान के अन्दर जाने का अवसर मिला है वे इस बात से भलीभांति परिचित होंगे कि भूतल से थोड़ा सा ही नीचे जाने पर अधिक उष्णता का अनुभव होता है। इस दिशा में किये गये गणनों के आधार पर यह पता लगा लिया गया है कि प्रत्येक ५० अथवा ६० फीट के उतार पर ताप में लगभग १°/F की वृद्धि होती है। ताप में इस गति से वृद्धि होने पर यह स्पष्ट हो जाता है कि मामूली सी ही गहराई पर असहनीय उष्णता होगी। और जब हम भूतल से ले करके पृथ्वी के केन्द्र तक की चार हजार मील लम्बी दूरी को देखते हैं तो वहां पर विद्यमान अति ऊँचे ताप का बोध हो जाता है। वैज्ञानिकों का ऐसा अनुमान है कि पृथ्वी के आन्तर का ताप लगभग ३०००°C और ४०००°C के बीच में है।

दबाव के विषय में भी यही बात सही है कि ज्यों ज्यों हम केन्द्र की ओर बढ़ते हैं, उसमें भी वैसे ही वैसे वृद्धि होती जाती है। गणनों के आधार पर हम कह सकते हैं कि प्रत्येक १००० फीट के उतार पर ५००० पौं० वेट का दबाव रहता है। अतः २५ मील की गहराई पर लगभग ६०,००० पौं० वेट का दबाव हो जावेगा। इससे भलीभांति स्पष्ट हो जाता है कि पृथ्वी के केन्द्रीय भाग पर अत्यधिक दबाव होगा।

जहां तक पृथ्वी के पदार्थ-विन्यास का सम्बन्ध है यह पता चल गया है कि पदार्थ का विन्यास विभिन्न सकेन्द्र परतों में है जिनका कि घनत्व क्रमशः केन्द्र की ओर बढ़ता जाता है। यह विन्यास बहुत कुछ प्याज के छिलकों की भाँति है। प्रसिद्ध भौमिकीविद् स्वेस महोदय ने भूतल से ले करके केन्द्र तक पृथ्वी का तृविभाजीय वर्गीकरण कर रक्खा है, जो कि क्रमशः स्याल(Sial), सीमा (Sima) और नीफे (Nife) हैं। उनके मतानुसार सर्वप्रथम स्याल भाग आता है जो कि भूतल से ले करके ७० और ८० मील की दूरी तक पाया जाता है। इसकी रचना अधिकांशतः ग्रैनाइट नामक शिलाओं की है। इस भाग में सिलीकान और अलूमिनियम तत्वों की प्रधानता होने के कारण इसका नाम स्याल पड़ा। यहां पर की शिलाओं का घनत्व २·७५ और २·९० के बीच में है। स्याल के उपरान्त सीमा नाम से विख्यात द्वितीय भाग प्रारम्भ होता है, जो कि स्याल की अपेक्षा कहीं अधिक विस्तृत है। इसकी रचना बेसाल्टिक शिलाओं की है। इस भाग में सिलीकान और मैगनीशियम तत्वों की प्रधानता के कारण से इसको सीमा कहा गया है। यहां की शिलाओं का घनत्व ३·१ के लगभग है।

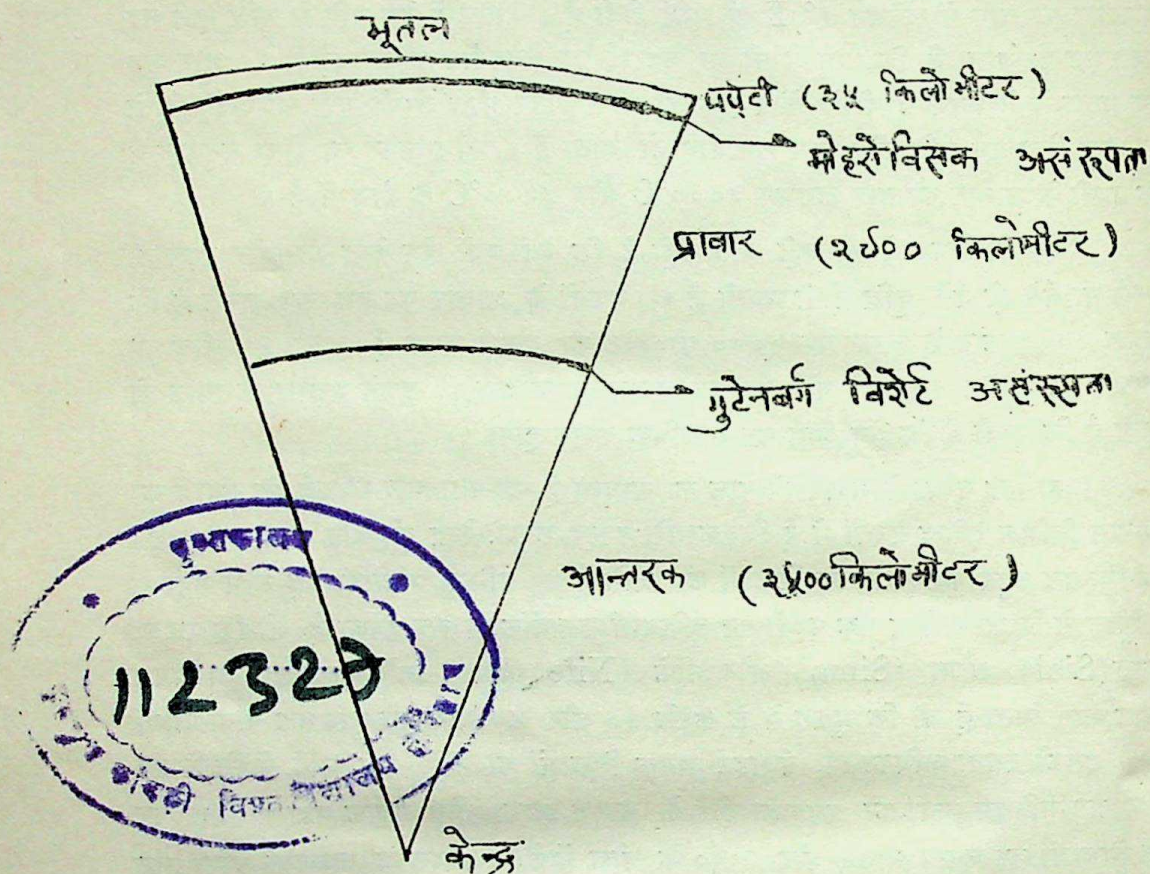
सीमा भाग के अन्तर्गत नीफे नाम से प्रसिद्ध तृतीय भाग आता है जो कि वस्तुतः पृथ्वी के आन्तरक की रचना करता है और यहां पर निकिल और आयरन, धातुओं की बाहुल्यता होने के कारण से इसे नीफे कहते हैं। यह अधिकांशतः धात्वीय रचना का है जिसका घनत्व लगभग १० है।

विलियमसन और एडम्स नामक अन्य दो और भौमिकीविदों के विचार भी स्वेस महोदय के समान हैं जिन्होंने कि पृथ्वी के पदार्थ का विन्यास केन्द्र की ओर बढ़ते हुए घनत्व के आधार पर किया है। परन्तु इनके अनुसार पदार्थ का विन्यास निम्न चार भागों में है (चि० १)।

(१) हल्के सिलीकेट और सिलिका द्वारा निर्मित पतली भू-पर्पटी।

(२) गुरु सिलिकेट का भाग।

(३) गुरु सिलिकेट और निकल आयरन के सम्मिश्रण का भाग जिसे पैलासाइट (Pallasite) कहते हैं।

(४) शुद्ध धात्वीय आन्तरक।

पृथ्वी का वर्तमान आंतरिक विन्यास

चित्र १

यहाँ पर यह भी बतला देना उपयुक्त होगा कि पृथ्वी का उपरोक्त विभाजन बहुत कुछ उल्काओं पर आधारित है। प्रायः जन-साधारण इन उल्काओं से परिचित है। कभी-कभी समाचार पत्रों में उल्कापातों के विषय में पढ़ने को मिलता है। वैज्ञानिकों का मत है कि ग्रह, उपग्रह, उल्का आदि सबकी उत्पत्ति का मूल स्रोत सूर्य है। अतः इन सबके पदार्थ, रचना और बनावट में भी समानता है। ये उल्काएँ निम्नलिखित तीन श्रेणियों में विभक्त की गई हैं—

(१) **सीडेराइट** (Siderite) **उल्काएँ** :—जो कि पूर्णतः धात्वीय होती हैं और निकिल तथा आयरन की निर्मित होती हैं।

(२) **सीडेरोलाइट** (Siderolite) **उल्कायें** :—जो कि निकिल आयरन तथा गुरु सिलिकेट की मिश्रण होती हैं।

(३) **एरोलाइट** (Aerolite) **उल्काएँ** :—जिन्हें प्रायः प्रस्तरीय उल्काएँ भी कहते हैं जो कि अधिकांशतः सिलिकेट की निर्मित होती हैं ।

इन्हीं उल्काओं के अध्ययन पर ही विलियमसन और एडम्स ने पृथ्वी को "Projectile of Nickel-Iron covered with slaggy crust" कह रक्खा है ।

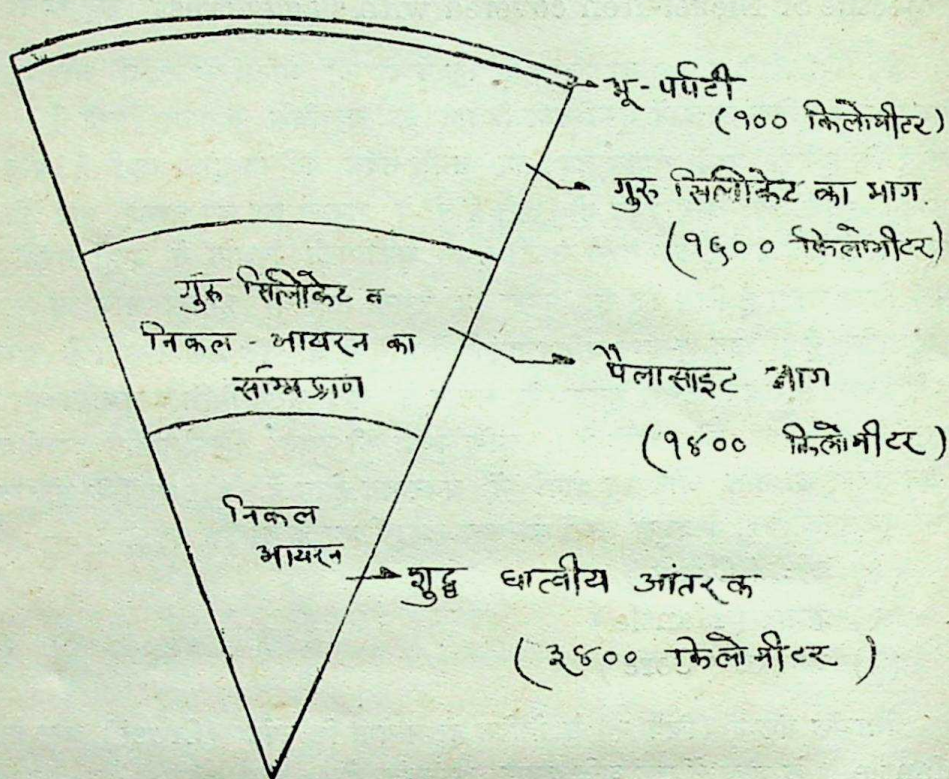
जैसा कि पहिले बताया जा चुका है कि पृथ्वी की आन्तरिक रचना और बनावट के विषय में आधुनिक काल में भूकम्पिकी विज्ञान से अत्यधिक सहायता मिली है । हमें विदित है कि हमारी पृथ्वी मानव हृदय की भांति सदैव कम्पित होती रहती है और जब यह कम्पन अति उग्र और प्रचंड हो जाते हैं तो वे भूकम्प का रूप धारण कर लेते हैं । इन भूकम्पों में कई प्रकार की तरंगे उठती हैं । भूकम्पिकी विज्ञान में इन्हीं तरंगों का अध्ययन किया जाता है जिस पर की पृथ्वी की रचना सम्वन्धी हमारा आज का सम्पूर्ण ज्ञान आधारित है । इन भू-कम्प जनित तरंगों में गति है जो कि भूकम्प आने के उपरान्त पृथ्वी के अन्दर से अथवा उसके भूतल के समीप से चल करके विभिन्न भूकम्पिकीय वेध-शालाओं में अनुरेखित की जाती हैं । चूंकि पृथ्वी की रचना वितरजातीय पदार्थ की है अतः इन तरंगों की गति और पथ दोनों में अवरोधन होता है, और इन्हीं के आधार पर वर्तमान भूकम्पिकीविदों ने प्रमुख भागों का पता लगा लिया है जो इस प्रकार हैं :—

(१) पर्पटी (Crust)
(२) प्रावार (Mantle)
(३) आन्तरक (Core)

जैसा कि संलग्न (चित्र २) से विदित हो जायेगा कि पर्पटी (Crust) और प्रावार (Mantle) के बीच में एक अति प्रमुख असंरुपता है । इस असंरुपता का पता सर्व-प्रथम मोहरोविसक महोदय ने लगाया था । अतः यह उन्हीं के नाम पर मोहरोविसक असंरुपता के नाम से प्रख्यात है । इसी प्रकार से प्रावार (Mantle) और आन्तरक (Core) के बीच में भी एक प्रमुख असंरुपता है जिसको कि खोज निकालने का श्रेय प्रसिद्ध भूभौमिकीविद् गुटनबर्ग और विशेर्ट महोदय को है । इसलिए इसे गुटनबर्ग और विशेर्ट असंरुपता कहते हैं । इन असंरुपता का पता उपरोक्त वर्णित भू-तरंगों के ही आधार द्वारा लगा था क्योंकि ज्यों ही ये तरंगें पर्पटी से प्रावार में अथवा प्रावार से आन्तरक में प्रवेश करती हैं उनकी गति में एक विशेष परिवर्तन हो जाता है जो कि इस बात का सूचक है कि पर्पटी का पदार्थ आन्तरक से भिन्न है ।

भूतल से लेकर के केन्द्र की ओर लगभग ३५ किलोमीटर तक पर्पटी का क्षेत्र है । यह प्रावार और आन्तरिक के तुलना में अत्यधिक पतली है । इसको दो भागों में विभक्त किया गया है—बाहरी ग्रेनाइटिकपरत, जिसे स्याल कहते हैं जो कि लगभग ११ किलोमीटर है और अन्दरुनी बेसाल्टिक परत, जिसे सीमा कहते हैं और जिसकी स्थूलता लगभग २४ किलोमीटर है ।

प्रावार की स्थूलता लगभग २९०० किलोमीटर की है । इसको चार भागों में विभक्त किया गया है ।

आन्तरक की स्थूलता लगभग ३५०० किलोमीटर की है और इसको दो भागों में विभक्त किया है। ऐसा अनुमान है कि आन्तरक का बाह्यभाग द्रव्यावस्था में है जब कि उसका आन्तरिक भाग ठोस पदार्थ का निर्मित है।

विलियमसन और एडम्स के अनुसार
पृथ्वी का आंतरिक विन्यास

चित्र २

अतः हमें फिर वही कहना पड़ता है कि मनुष्य के अध्यवसायी व जिज्ञासु स्वभाव का परिणाम है कि उसने पृथ्वी के गर्भ का भी इतना सही सही पता लगा लिया। वर्तमान युग में होने वाले इस क्षेत्र के अनुसन्धान एवं अन्वेषण इस विषय में रही सही शंकाओं का भी अवश्य समाधान कर देंगे, ऐसा लेखिका का विचार है।

अंत में लेखिका को यह स्वीकार करना पड़ता है कि क्या इस प्रकार का वैज्ञानिक लेख लिखना उसके लिए संभव था यदि पूज्य डा० राजनाथ तथा डा० वी. डी. शुक्ल जी से सतत प्रेरणा और प्रोत्साहन न मिला होता? विचार भाव और भाषा सब कुछ आदरणीय गुरुजनों के ही हैं, केवल बारम्बार लिखना और लिखकर के सही कराना इतना ही लेखिका का है।